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THE ARNOLD ARBORETUM  
HARVARD UNIVERSITY

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# ARNOLDIA



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JEANNE S. WADLEIGH, Editor

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*Cover: Helleborus niger. Photo: R. Weaver.*

# The Hellebores

by RICHARD E. WEAVER, JR.

*Helleborus* is a genus of the Crowfoot Family (Ranunculaceae) including about twenty species native to southern Europe and western Asia. Several species, particularly *H. orientalis*, the Lenten Rose, have been cultivated as medicinal plants since classical times, and they are still important plants in modern gardens because of their beautiful, often oddly colored flowers which appear in winter or early spring, and their bold, handsome foliage.

Like many members of the Crowfoot Family, the showy parts of the flowers of the hellebores are sepals rather than petals. These are generally five in number, and they vary in color from green or white through pink to deep red-purple. The petals are reduced to a ring of nectaries which are mostly obscured by the very numerous and conspicuous bright yellow stamens. The flowers often remain fresh and functional for nearly a month, but they remain on the plants for a much longer period, the sepals persisting and gradually turning green or purplish as the fruit matures.

Perhaps a dozen species and their various hybrids are cultivated in Europe, but only the following are generally available from American nurseries.

## ***Helleborus niger*.** Christmas Rose

This is certainly the best known and most frequently cultivated species at present, and it is, in my opinion, one of the finest herbaceous plants of any sort that can be grown in New England. As the common name implies, the flowers are similar at a glance to those of a single rose, but unfortunately they are not fragrant. In England or their native southern Europe, the plants may bloom soon after Christmas. But in my garden the flowers have not appeared before early March, even though the buds, large and plump and perfectly formed, may be found just at ground level at the very onset of winter. When they do appear, the 2-3-inch flowers, pure white or with a tinge of pink, rising on short stalks above the magnificent, leathery, almost palmlike foliage, seem almost unreal in a world barely past the dead of winter.

Several varieties and cultivars are available in the trade. Those with particularly large flowers include var. *altifolius* and 'Potters Wheel'. The var. *macranthus*, often listed as a separate species, has

gray-green foliage and the flowering stems are seldom more than 8 inches tall.

Although I can never quite bring myself to cut one, the flowers of the Christmas Rose reportedly last very well when they are brought into the home, at least if the stalk is slit at the base. Outdoors they can usually take the worst March has to offer, but the often recommended practice of protecting them with a basket will, at least, prevent them from being hidden for even a few days by that inevitable snowstorm.

***Helleborus orientalis*. Lenten Rose**

The Lenten Rose is native to Greece and Asia Minor, but it and its hybrids appear to be quite hardy in the Boston area. It is more likely to live up to its common name than the Christmas Rose, and normally blooms here with the early daffodils in April or early May. It is similar in aspect to *Helleborus niger*, but the leaves are larger (often a foot or more across), glossier, with finer and more numerous regularly spaced teeth. In addition, the flowering stalks are frequent-



*Left: Helleborus corsicus (as H. lividus), from Botanical Register, vol. 24, plate 54, 1838.*



*Right: Helleborus orientalis, from Botanical Register, vol. 28, plate 34, 1842.*





*Helleborus niger* var. *macranthus*, a *Christmas Rose*. Photo: R. Weaver.

ly branched and bear conspicuous leaflike bracts. The flowers are creamy to brownish in the wild plant, but this is rarely seen in cultivation now. Most plants presently passing as Lenten Roses are actually hybrids with *H. orientalis* as one of the parents. Flowers range in color from apple green through pink to maroon. The so-called Millet Hybrids bear flowers that are frequently streaked reddish inside, suggesting the presence of the Caucasian *H. guttatus* in their ancestry.

Although they are fine garden plants with beautifully colored flowers, the Lenten Roses are not so refined as the Christmas Rose and must be sited carefully. They are rather large and informal, and they look best planted among evergreen shrubs. The large leaves, while remaining evergreen, are generally flattened to the ground with the first snowfall, and even a single-crowned plant may then be almost a yard across.



*Helleborus foetidus*, showing the habit of the plant, from H. Baillon, *Histoire des plantes*, vol. 1, 1867.

***Helleborus corsicus* (*H. lividus* subsp. *corsicus*)**

This and the following species differ from the first two in that the flowers are borne at the tips of leafy stems rather than arising directly from the crown on naked scapes. Well-grown plants must be impressive and attractive, with their 12-15-inch stems bearing trifoliate, sharply toothed and heavily veined leaves and crowned with a branched cluster of ten to twenty green flowers. But I have not

found *H. corsicus* satisfactory in my garden. Being a native of Corsica, it is not surprising that this species is a bit tender. I have had a plant survive the past two winters, but spring has found the stems weak and flattened and the flower buds mostly blasted. In areas without heavy winter snowfall, this is no doubt a very fine plant. Even here it might be satisfactory if it were protected with an overturned basket.

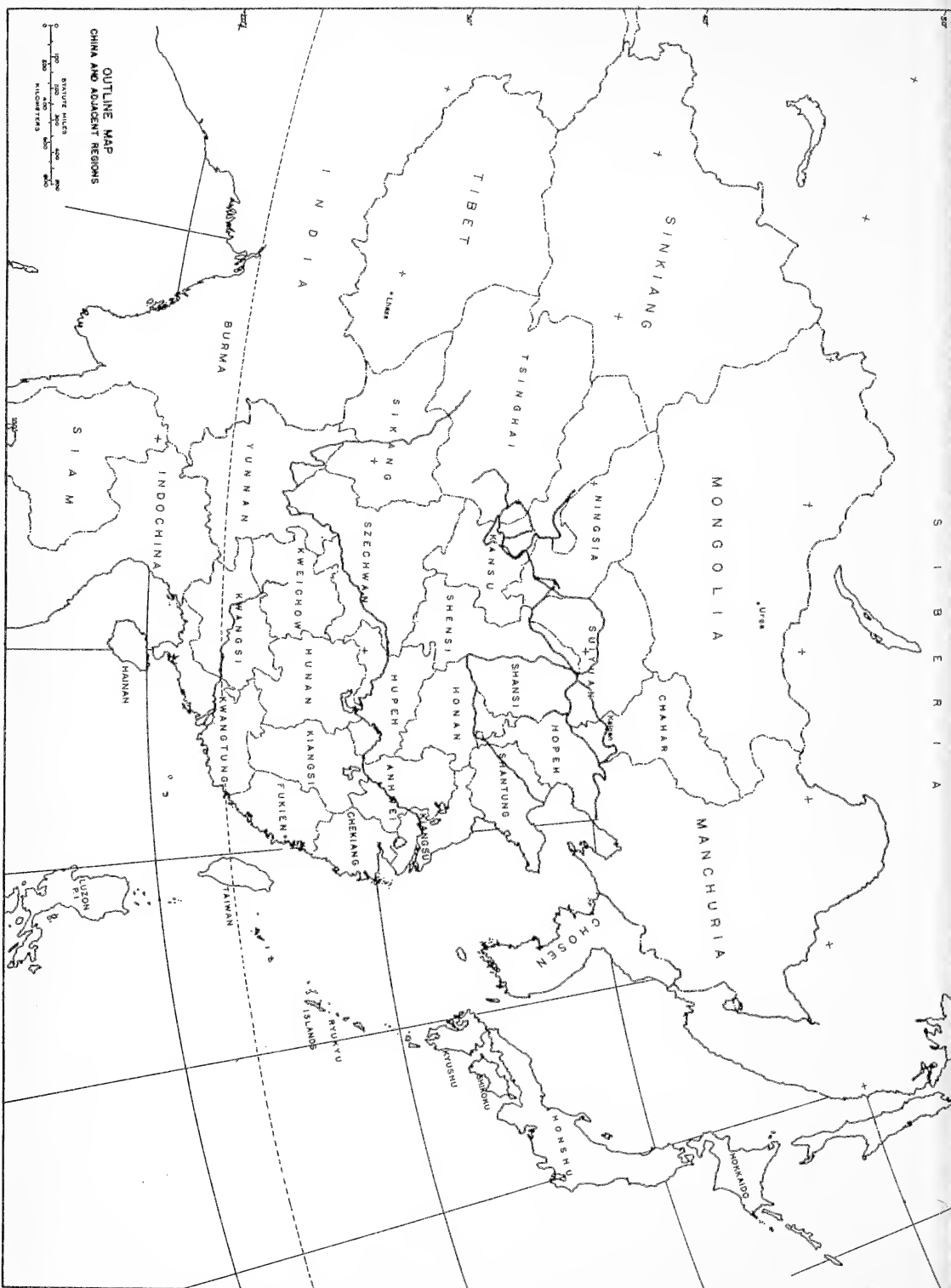
### ***Helleborus foetidus*. Stinking Hellebore**

I have not grown this plant, but since it ranges into western Europe it should be one of the hardiest of the hellebores. It is rare in cultivation in this country, and at present I know of only one source — Lamb Nurseries in Spokane, Washington, which is, in addition, the only nursery that lists all the other three species discussed here. *Helleborus foetidus* is similar in aspect to the preceding species but the leaves are more finely divided and the green flowers are often rimmed with purple. As the Latin name implies, the flowers have an unpleasant odor; they appear in April and May. I suspect that *H. foetidus* also needs protection from the weight of the snow in winter.

Hellebores will not prosper unless they are planted in a good, deep soil that never dries out. Deciduous shade, or the shade of a house at midday is ideal. A few applications of a water soluble fertilizer during active growth in the spring are beneficial, and for best results the soil should be near neutral or slightly alkaline. These plants have a reputation for being difficult to transplant, some accounts stating that they will not flower for several years after being moved. If reasonable care is taken, and the long, thick roots are not seriously damaged, this reputation is unfounded. And of course, young plants move better than do mature ones. However, hellebores are highly susceptible to crown rot, so if they are to travel through the mail I would recommend ordering in the spring from a small specialty nursery. Plants from such an establishment will probably be young and either pot-grown or freshly dug.

Most hellebores are long lived and slow in increasing, so they seldom need division except for propagation purposes. Division can be done most anytime with proper care, and this is recommended over seed propagation because the seeds are often slow to germinate and the resulting plants usually take at least four or five years to flower.

Although all parts of these plants are probably poisonous, they should not be a problem in the home garden because there is little about them that would attract children.





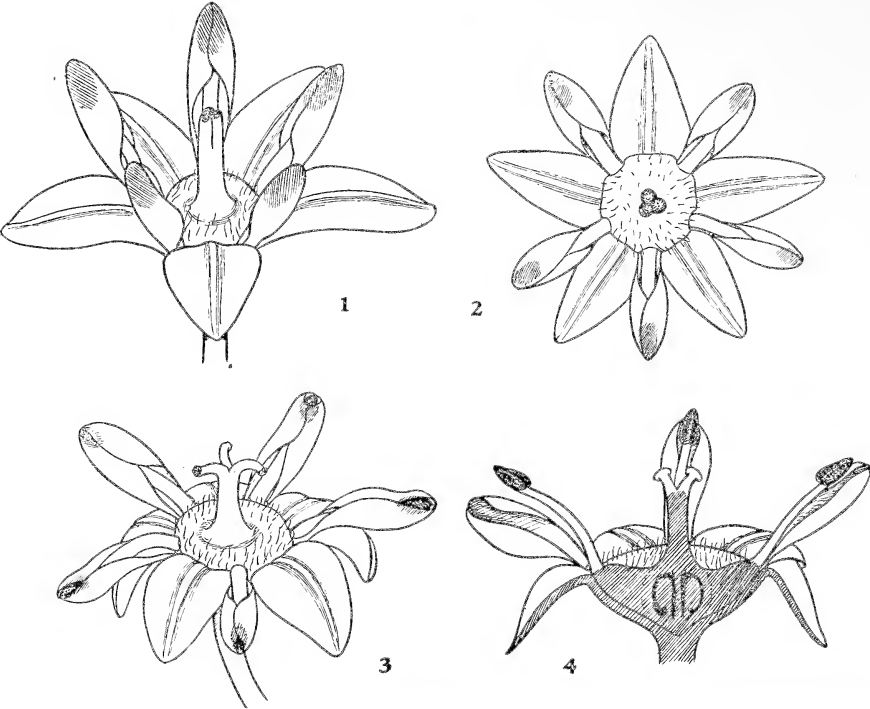
# The Raisin Tree - Its Use, Hardiness and Size

by GARY L. KOLLER and JOHN H. ALEXANDER III

Interest in unusual plants that produce edible parts seems to be on the increase. One such plant, almost totally unrecognized in Western literature, is the raisin tree (*Hovenia dulcis*) which in Chinese is known as Chih-chü. This Rhamnaceous plant derives its common English name from the enlarged and irregular flowers stalks that have been sold as fruits in the Peoples Republic of China since pre-Confucian times. These stalks are small and inconspicuous but they rapidly increase in size as the fruit matures. With maturation, and after frost, the pedicle color changes to russet and the interior of the stalk is filled with a yellowish pear-flavored pulp. Individually, the stalks are small, but abundant production compensates to produce bulk and this results in a crop that requires labor-intensive harvest techniques. The enlarged pedicle is unusual in that it is not part of the fruit structure but is entirely distinct and subtends the pendent terminal fruits. The ripe fruits are small, dry, rounded, three-celled capsules about the size of a pea. Each contains three flat, shiny black to orange-brown seeds. In China these seeds are sold under the name of Chih-chü-tzü.

From what these authors have been able to ascertain from the literature and through discussion with Dr. S. L. Hu, a Chinese botanist, the ripe pedicles are collected from the wild by small school children instead of being cultivated in orchards as a crop. If cultivars have been selected in the Orient, they are unknown to us. Perhaps commercial interest could be enhanced by the selection of plants with larger pedicles, higher sugar content, greater productivity or more reliable annual fruit production.

G. A. Stuart in *Chinese Materia Medica* says: "Both the fruits and the fleshy peduncles are considered to be antifebrile, laxative, diuretic and quieting to the stomach. Remarkable antivinous properties also are attributed to them. It is said that after the ingestion of large quantities of alcohol the use of this drug will prevent any intoxication or poisonous action. The bark of the tree is used in diseases of the rectum." K. C. Chang in *Food in Chinese Culture* states that hovenia is sometimes styled 'tree honey' in Chinese for the sweet extract of the seeds, bough and young leaves is a common substitute for bee honey.





This 53-year-old raisin tree (A.A. 19571) is the Arnold Arboretum's best specimen with a height of 35 feet and a spread of 22 feet. Photo: E. Gray.

H. F. Chow in *The Familiar Trees of Hopei* indicates that this is a valuable commercial species. In addition to food and medicinal use, its wood is hard and heavy, and is used for manufacturing furniture, etc.

As a wild population, this plant finds its native home in China, Korea and Japan, where it occurs in the warmer portions of these countries. In Japan it occurs on the Okushiri Island of Hokkaido as well as on the islands of Honshu, Shikoku and Kyushu. In China it is found in provinces of Hopei, Honan, Shantung, Chekiang, Hupeh, Hunan, Szechuan, Yunnan, Kweichow, Kwangtung and Fukien. Through cultivation the plant was introduced very early into India.

Left above: Flower of *Hovenia dulcis*, from *The Botanical Magazine of Tokyo*, vol. 53, no. 635, 1939.

Below: *Hovenia dulcis*, from *The American Garden*, vol. 12, 1891.

The Chinese literature lists *Hovenia dulcis* as growing to 30 feet with an equal spread. It is said to occur in shady glens in moist situations where it forms extensive thickets, and occasionally in the mountains as a secondary plant that occurs at altitudes ranging from 500 to 4,000 feet.

While this species was introduced into cultivation in the west in 1820, it remains little known even in many botanical collections. At the Arnold Arboretum two large trees are alive and thriving as of December 1978. The best specimen (A.A. 19571) was obtained as seed on December 24, 1924 from the Botanic Garden in Washington, D.C. When planted out in 1931, the tree was placed in an exposure of full sun on a southeast facing slope which is one of our warmest microclimates. In December 1978 at fifty-three years of age, this tree is approximately 35 feet tall with a spread of 22 feet. A single trunk divides at approximately 12 inches above the soil line into two major stems. The largest branch has a D.B.H. of 1 foot 1 inch, and the lesser a D.B.H. of 11 1/2 inches. The tree has a rounded head, strong u-shaped crotches, deep roots and no visible sign of die-back or breakage from ice and snow. Average stem growth was 12 inches for current year's wood. The 1978 growing season produced an abundant crop of seeds.

The second plant (A.A. 87-33) was collected on January 18, 1933 by W. H. Judd as seed from the Botanic Garden in Washington, D.C. It is interesting to note that the two surviving trees at the Arnold Arboretum both originated from the same seed source. This tree was permanently planted in 1937 near the first plant described, but instead of having an exposure of full sun, the plant is shaded and stretches for light. At forty-five years of age, this tree is approximately 30 feet tall but its spread has been greatly distorted by competition from neighboring plants. The D.B.H. of the single stem is 10 1/2 inches. No fruiting is evident for the 1978 season.

The earliest accessions of this plant at the Arnold Arboretum were in 1880 when seeds were received from the Agricultural College in Sapporo, Japan, and a plant was sent from S. B. Parsons and Sons, a nursery in Flushing, New York. None of these plants survives but the early records do not indicate the reason for failure.

Three specimens exist in December 1978 at the Morris Arboretum in Philadelphia, Pennsylvania. One is a towering giant (M459) with a height of 78 feet and spread of 68 feet. This tree has an interesting history as related by Joseph Adams of the Arboretum staff. When he started work at the Morris in February 1933, the tree was already a large specimen of at least 30 feet in height, but the records lacked a source or age for the plant. The winter of 1933-34 was devastating with gusting winds and a record of -17°F. The tree froze back to within a few feet of the ground. However, it recovered by sending out vigorous shoots from the main trunk and in 1942 after eight growing seasons, attained a height of 31 feet and a spread



*Leaves and fruit of Hovenia dulcis.*  
*Left: from Peking Natural History*  
*Bulletin, 1934. Right: from Botanical*  
*Magazine, vol. 50, 1824.*

of 35 feet. So its present height of 78 feet was achieved with the backing of a strong, well-established root system, in only forty-five years. This tree has two trunks that divide from a single stem at approximately 1 foot above the soil line. The east trunk has a D.B.H. of 2 feet 4 inches and the west trunk a D.B.H. of 2 feet. Mr. Adams only can remember the tree fruiting twice, with the last time being approximately 1975.

As with many living things, this tree was struck by tragedy. Approximately a year and a half ago, lightning hit the plant causing major bark fissures, thinning of the canopy and loss of vigor. Despite this, the tree survived the stresses of an unusually cold winter in the 1977-78 season. This is perhaps the largest specimen existing in North America and larger than any mentioned in the literature reviewed by these authors.

The Morris Arboretum also has two lesser specimens. One (52-66-A) is 40 feet tall with a spread of 34 feet. It produced an abundant crop of seeds in 1978. The other (57-226) came to the Morris as a B & B specimen from the Taylor Arboretum in 1957. Today this plant is 45 feet tall, spreads 30 feet and rises as a single stem with a D.B.H. of 11 inches to the height of 8 or 10 feet before branching.

Documentation of cold hardiness has been limited, but Allen Cook,



*The bark of hovenia is light gray with occasional exfoliated layers revealing colors of warm, reddish-brown. Photo: E. Gray.*

horticulturist at the Dawes Arboretum in Newark, Ohio offers the following observations: Seeds were received from Highland Park in Rochester, New York in 1967. They were stratified at 40°F for forty days and two known plants resulted. After attaining some size in a nursery area, the plants were put into permanent locations in June of 1975. The sites selected were protected from winds, with a north

or northwest exposure and good drainage. The winter of 1975-76 was severe with temperatures to  $-10^{\circ}\text{F}$ ; both of the newly transplanted plants froze to the ground. However, in spring 1976, both sprouted from the root system and by the end of the growing season one was 3 feet tall and the other 5 feet tall. Nature provided a tougher test the following winter with low temperatures of  $-23^{\circ}\text{F}$ , and both trees died.

While one could never describe *hovenia* as outstanding from an ornamental perspective, it does have several notable features. The broadly ovate leaves are a glossy dark green and remain remarkably free of insects and disease. At the Arnold Arboretum during the summer of 1978 the largest plant produced many flowered, terminal cymes of pale creamy-white flowers in mid- to late July, followed by fruit clusters that ripened in October. Gray bark with narrow but deep fissures in the vertical plane gives a series of rectangular plates which occasionally exfoliate and reveal delightful contrasting colors of reddish-brown. Viewed from some distance, the smaller branches are not straight as an arrow, but undulate in long waves giving the branch structure a visually fuller appearance.

From the observations of these authors, the tree appears to grow best in full sun and it seems to be pH adaptable and thrive in a wide range of soil types.

Propagation experiments were performed in 1963 at the Arnold Arboretum to determine the best method of germinating the seeds. Five lots of two hundred seeds were treated. Lot 1 was sown with no pretreatment. Seeds of lot 2 were cold stratified for three months at  $40^{\circ}\text{F}$  before sowing. Lot 3 was stratified at fluctuating greenhouse temperatures of from  $45^{\circ}\text{F}$ – $80^{\circ}\text{F}$  for three months, followed by three months of cold stratification. Seeds of lot 4 were scarified in concentrated sulfuric acid for one hour prior to sowing; lot 5 received the one hour of acid treatment plus three months of cold stratification.

The two lots of acid treated seeds gave the best results with germination percentages of slightly better than 40 percent while the highest percentage from lots 1-3 was the 3 percent achieved by lot 1. These results indicate that germination is inhibited by a hard, impermeable seed coat, and imbibition of water and germination cannot occur until the seed coat becomes permeable. This would occur in the soil over a long period of time while the seed coats were slowly degraded by natural forces. Scarification by acid treatment or by mechanical means such as filing or sandpapering hastens seed coat degradation and permeability, thereby allowing germination.

Later experiments at the Arnold Arboretum with acid scarification of *hovenia* seeds have been performed with acid treatment of 1 1/2, 2 and 2 1/2 hours. General germination occurred at both the 2 and 2 1/2 hour treatments with the 2 1/2 hour treatment appearing slightly better.





*Hovenia dulcis* growing in Yunyang Hsien, Eastern Szechuan, China, at an altitude of 3,000 feet. The tree is 70 feet tall with a circumference of 6 feet. Photographed by E. H. Wilson on July 3, 1910.



In researching this article, the authors found several references stating that cuttings of ripe wood could be rooted, but no literature to substantiate this could be found. The Arnold Arboretum records show that cuttings were taken in March 14, 1929 and that at least one of the cuttings rooted, for it was planted out on the grounds in 1933. Experiments to determine the best method of asexual propagation are now underway at the Dana Greenhouses.

In order to promote further testing of this plant, we have gathered a large quantity of seeds from our older plant. These seeds will be available to members only on a first-come-first-served basis until May, 1979. In requesting seeds, please enclose a self-addressed, stamped envelope and address the request to:

Hovenia Seeds  
The Arnold Arboretum  
The Arborway  
Jamaica Plain, MA 02130

Because the available literature on this plant is sparse, it would be interesting to hear from others who have grown or observed the raisin tree. Additional firsthand comments will help us document the use, cold hardiness and ultimate size of *Hovenia dulcis*.

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# The Allegheny Pachysandra

by MICHAEL A. DIRR and JOHN H. ALEXANDER III

Repetition seems to be the rule with groundcovers for the same taxa are used repeatedly and few attempts have been made to educate the public or offer it alternative selections. *Euonymus fortunei* 'Colorata', *Hedera helix*, *Pachysandra terminalis* and *Vinca minor* are the dominant offerings and comprise probably 50 to 60 percent of the total groundcover used in the East and Midwest. None of these groundcovers is without problems and in recent years *Pachysandra terminalis*, Japanese pachysandra, has been afflicted with *Volutella pachysandrae*, a fungal pathogen, that causes cankers and stem die-back. A severe infestation can literally devastate an established planting. Controls are available, but often by the time the homeowner recognizes that a problem exists, it is too late for effective treatment. The monoculture of trees (Ex: American elm) should have taught us something; however, the same type of mistake is being repeated with groundcovers.



An American species, *Pachysandra procumbens*, Allegheny pachysandra, is one of the most handsome plants for groundcover use, yet is seldom seen in gardens or in commerce. This fact has been lamented by other authorities (4, 6, 7, 8) and the species suffers a fate common to other quality plants: entrapment in the confines of an arboretum or botanic garden. Several reasons for the lack of visibility include limited publicity compared to its Japanese cousin, and the purported difficulty of propagation. Division (4, 8) offers a suitable means but is excessively slow for commercial purposes.

The plant was discovered by Andre Michaux in the 1790's and was described in his *Flora Boreali-Americana* (3). Its range was listed as the western Allegheny mountains; hence the derivation of the common name. Braun (2) noted that the species is found in Kentucky, Tennessee, northern Alabama, Mississippi and northern Florida. The species also occurs in North and South Carolina. Wherry (8) studied native stands from Somerset, Kentucky, south to the Gulf of Mexico. He noted that the plant abounded on rocky slopes, being most at home in woods, but persisted even where trees had been cut and land pastured. The underlying rock was limestone and the soil reaction was circumneutral (around pH 7). According to Wherry, most plants were situated on slopes along streams.

The species is hardy far north of its range and is successfully cultured at the Morton Arboretum, Lisle, Illinois as well as at Champaign-Urbana, Illinois, where temperatures may reach  $-20^{\circ}$  to  $-25^{\circ}\text{F}$ . A planting has been maintained since 1962 at the University of Minnesota Landscape Arboretum where winter lows reach  $-30^{\circ}\text{F}$ ; however, snow cover is usually constant and affords protection.

The Arnold Arboretum has plantings that have not been disturbed since June, 1943. One measures 3 by 4.5 feet and another, 3 by 7 feet. The former is on the east side of the Administration Building while the latter is on the north side and hemmed in by the parking lot and building so it can spread in only two directions. There is no evidence of any disease or insect problems in the plantings. The species' extreme shade tolerance is evidenced by the excellent performance in these locations. Under landscape conditions, a moist, well-drained, organic, slightly acid soil would probably prove optimum. Any plant that increases by rhizomes or underground rootstocks benefits from a loose, friable soil because there is less physical impediment to the expanding structures.

Summer foliage ranges from a grayish- to bluish-green with a slight mottle and does not possess the luster of Japanese pachysandra. The leaves assume a bronze color in the late fall and by winter's termination range from greenish-brown to brown. The foliage is not truly evergreen and may vary from deciduous to semi-evergreen.

*The broad, outer, dull bluish-green leaves of Pachysandra procumbens often develop a mottled appearance. Photo: M. Dirr.*



Above: *Pachysandra terminalis*. Although leaf arrangement is alternate, the nodes are so closely spaced that a rosette-like condition results.

Below: *Pachysandra terminalis*. The specific epithet, *terminalis*, is derived from the position of the inflorescence. Photos: M. Dirr.



Leaf retention depends on siting and geographic location. The species forms a handsome carpet that varies from 6 to 10 inches in height. If the foliage deteriorates over winter, abundant new shoots will have developed to form a solid cover by May or June. The leaves are much wider than the Japanese species and display more prominent (coarser) serrations. Although alternate in arrangement, the leaves appear whorled because the nodes are so closely spaced. They range in size from 2 to 3 1/2 inches long and almost as wide.

The flowers are especially attractive and develop in March and April on 2- to 4-inch-long spikes that emanate from the base of the stem. A single stem may have up to three spikes, but one is more common. The position of the flower provides another means of separating the two species, for on Japanese *pachysandra* the inflorescence is at the top of the stem in the middle of the pseudo-whorl of leaves. The flowers of *P. procumbens* are a purplish- or pinkish-white (stamens may be pink in color) and possess a pleasing fragrance. Wherey termed the odor rancid and musky, but based on personal observation this is not the case. The flowers are unisexual and apetalous with male and female on the same inflorescence. A few female flowers are confined to the base of the inflorescence while the conspicuous and abundant stamens occur at the top. Both species have naked (not hidden by bud scales) inflorescences, which are formed the summer and fall prior to flowering. Unfortunately, if the Allegheny *pachysandra* is killed to the ground, the flowers will be lost. Even though they are basal, they elongate and partially rise above the foliage which is often flattened by winter weather. The early flowering date couples the species with *Acer rubrum* and together they could be considered "harbingers of spring."

Fruits are not showy and apparently seldom develop in cultivation. Examination of herbarium specimens of material collected from the wild showed that the fruit is a three-valved capsule that contains small lustrous, dark brown seeds. The fruit is not ornamental on either species, but perhaps controlled crosses might be made between the two thus resulting in interesting hybrid progeny.

The Cornell Plantation (1) reported that Allegheny *pachysandra* was unfamiliar to many visitors and stimulated more questions than any other plant in their groundcover collections. They further noted that the species was not evergreen in Ithaca, New York, but perfectly hardy, and that twelve-year-old plantings showed no disease or dieback problems.

Propagation difficulties may have limited commercial offerings in the past, but this is no longer a problem. Cuttings of vigorous semi-hardened growth taken in June have rooted readily (1). In experiments at the Arnold Arboretum, cuttings collected in September rooted no less than 80 percent in eight weeks when placed in sand and perlite under mist. Ten treatments were employed and even the controls rooted, but indolebutyric acid (IBA) and naphthaleneacetic





*Pachysandra procumbens*. The basal inflorescences are formed the summer prior to flowering and range in number from one to three per stem. Photo: M. Dirr.

acid (NAA) when applied as dips (pure chemical dissolved in 50 percent ethanol) resulted in 100 percent rooting and large root systems.

Allegheny pachysandra is an aesthetically functional alternative to the more common groundcovers. Ask your local nurseryman or garden center operator for help in locating plants. The following firms may serve as an alternative if there are no local sources:

The Wild Garden  
Box 487  
Bothell, Washington 98011

Brookside Nursery, Inc.  
Darien, Connecticut

Weston Nurseries  
Hopkinton, MA

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*Mature leaf of Pachysandra terminalis showing wedge-shaped leaf base and prominent terminal serrations. Photo: M. Dirr.*

## NOTES FROM THE ARNOLD ARBORETUM

### The Gift of Time

by MARGO W. REYNOLDS

Selflessness is a quality rarely encountered anymore in today's "me first" society. Fortunately for the Arnold Arboretum, however, and for similar institutions, there still are people who think that helping others is a reward in itself, one that brings gratification to both the giver and the receiver. The generous men and women who comprise the volunteer program at the Arnold Arboretum are just such people and it gives me great pleasure in this issue to salute and applaud them.

The Arnold Arboretum's volunteer program was launched in 1971 in anticipation of our Centennial celebration. Volunteers were particularly active at this time in preparation for the event, and continued to be invaluable during the Centennial as tour guides, organizers, and in numerous other capacities. Currently, there are about thirty volunteers, twenty-two of whom are regular in their participation; others come in for special projects, or as they are needed. The ranks will be increased in February when another training program is scheduled to begin.

Now that these good people have been part of our lives for nearly eight years, it is hard to imagine the Arboretum without them; it simply would not be the same. We are a small staff and we are, every one of us, stretched to our limits much of the time. Somehow, with everyone putting in a little extra, we manage to accomplish the possible; the essential tasks that must be done to keep an arboretum running. It is often only with the help of our volunteers, however, that we are able to do the impossible; those extras that we could not do ourselves, the extras that make a difference.

But for our volunteers, the exhibition gallery would stand empty much of the year, for none among the staff have the months required to research, document, locate photographs for, and assemble such comprehensive exhibits as "Spreading Roots," "Flora From Shakespeare" and others.

The public would never have the opportunity to visit the greenhouses to learn about the workings of a propagation facility because there would be no one with the time to give tours, patiently explaining the set-up, the equipment, the plants and the various horticultural practices in use.



Our gates would be closed, of necessity, to any and all groups desiring guided tours of our 265 acres in Jamaica Plain and at the Case Estates in Weston. It would be unthinkable, of course, to stop encouraging people to visit this spot of inordinate beauty from which there is so much to learn, but the staff cannot possibly handle all the school groups, garden clubs and others who request individual attention.

We certainly would have to discontinue the distribution of plant dividends to Friends. The time involved in wrapping, packing, addressing, stamping, sorting, and mailing thousands of small plants every year is prodigious. We could do what other organizations have done, I suppose, and contract the mailing out — but the cost of a membership would rise considerably.

We would have to severely curtail our distribution of seeds to other arboreta and botanical gardens. Who would do all the collecting (much of it in the extreme humidity of summer or in the biting cold of winter), not to mention the meticulous cleaning, sorting and preparation required before a seed even leaves our hands?

Friends who enjoy the book reviews in *Arnoldia*, and who consult them when purchasing items for their personal libraries, would have to make do with fewer in each issue. Reading and reviewing books is something most of us have time to do only after the daily paperwork is completed, and that free time is limited.

Magazines, newspapers and libraries requesting slides of the Arboretum or of specific plants would have to write their articles or plan their displays without the added visual impact that a picture provides. Who would do the mounting, cleaning, sorting, labelling, filing and organizing that are necessary to keep a slide collection functioning and useful?

Clerical work would fall behind, nursery inventories might never get done, the cone collection would still be in disarray, collecting would slow down, mapping and labelling would fall behind, periodicals would remain unshelved, the leatherbound books would deteriorate if not cleaned, there no longer would be a continuous floral display in the entrance hall to greet visitors, there would be fewer educational courses and tours, there would be no one to translate foreign texts . . . things would be, oh, so very different.

The above are only the tangibles, however; they represent but a fraction of what the word "volunteer" means at the Arnold Arboretum. Nearly as important are the intangibles; those special little touches that add a personal element to each volunteer/staff relationship. Did you know, for instance, that the retired physician who works so industriously in our conifer collection is also the reserve center on our lunchtime football team? Make no mistake about it — the game's more fun when Dr. Richard Warren is in it. And you can't convince the staff that Christmas is on December 25. Our Christmas arrives on the eagerly awaited day that volunteer Catherine Hull



*A group of Arnold Arboretum volunteers poses beneath a hardy silk tree at the Case Estates following a luncheon meeting there last September. Back Row (left to right) Albert Thompson, Gertrude Cronk, Barbara O'Connor, Janet Thompson, Richard Dwight, June Hutchinson, Robert Siegel, Nathaniel Whittier, Leslie Oliver, Louis Segel. Front Row (left to right) Cora Warren, Doris Loomis, Marie Dempsey, Loretta Wilson, Sheila Magullion, Elinore Trowbridge, Sylvia Grey.*

brings her famous, transitory, homemade marshmallow fudge. An appearance by Lou Segel always means a joke. It never fails to lighten the moment and oftentimes its after-effects linger to brighten the whole day.

We use all of the many talents of our volunteers. The retired English professor who works several mornings every week cleaning seeds and preparing nursery inventory at the greenhouse recently delighted a large audience at one of our Wednesday luncheon lectures with a marvelous reading of Robert Frost's poetry. Yet another volunteer, a retired surgeon, recounted in a fascinating slide presentation his trip to Japan with the Boston Symphony Orchestra. Our youngest volunteer, a fifteen-year-old high school student, recently won a prestigious award from the National Rose Society for his work with those plants. A young blind volunteer is teaching us all that lack of sight is not a limitation when there is the desire and the perseverance to work with plants.

We are immeasurably enriched by our volunteers — our friends. The staff may be the timber of the Arboretum house, but the volunteers are certainly the nails that hold us together, for they give us that most selfless gift of all — the gift of time.



*Carpinus betulus.* Photo: M. Dirr.

## ARNOLDIA REVIEWS

**Magnolias.** Neil G. Treseder. London and Boston: Faber and Faber. xviii + 243 pages + 48 plates. \$59.95.

It is a great pleasure to bring to the attention of readers of *Arnoldia* the publication of Neil Treseder's long awaited book. Published in collaboration with the Royal Horticultural Society, this volume is destined to become a sought-after classic and collector's item for both present and future horticulturists and botanists.

Based on extensive research into both the botanical and horticultural literature, the main body of Treseder's text presents detailed descriptions of all the north temperate zone species of the horticulturally important and botanically intriguing genus *Magnolia*. Coupled with a chapter entitled 'Revised Survey of the genus *Magnolia* together with *Manglietia* and *Michelia*' contributed by the late James Edgar Dandy (formerly of the British Museum (Natural History) and world authority on the Magnoliaceae), Treseder's book is the closest approach to a monograph of *Magnolia* that has appeared in print. The descriptions of the species and their cultivars, as well as those of the numerous interspecific hybrids of garden origin (to which a section of forty-six pages is devoted) are supplemented by important discussions of the cultural and historical aspects of each taxon, as well as problems relating to their classification, taxonomy, nomenclature, and distribution and original discovery in nature. These descriptions and discussions are greatly enhanced due to Treseder's firsthand knowledge and observations of magnolias in cultivation.

The fourth generation to head the world famous Treseder Nursery, Ltd., Truro, Cornwall, England, Neil Treseder grew up in what might easily be termed "Magnolia Country." Close at hand are the world famous collections of magnolias in Cornish gardens, particularly those at Caerhays Castle and at Trewithen, the home of the late Col. George Johnstone, whose *Asiatic Magnolias in Cultivation* (Royal Horticultural Society, 1955) has since its publication been the standard reference for species of Asiatic origin and can be considered the precursor of Treseder's book. These famous Cornish gardens contain many of the original introductions of Wilson and Forrest, among others, and are the gardens in which several of the more spectacular garden hybrids have arisen. Moreover, Treseder has traveled widely to observe magnolias, including at least one trip to North American gardens, and has corresponded with numerous members of the American Magnolia Society, of which he is a member. On the practical side, Neil Treseder brings years of experience as a practicing nurseryman to bear in the section entitled 'How to Grow Magnolias.' This practical guide covers topics including propagation, pests and diseases, planting, and cold hardiness, while another section outlines the techniques used in hybridization.

Throughout, the volume is well illustrated with line drawings by Marjorie Blamey, while thirty-nine color photographs and nine color reproductions of her original paintings are reproduced on eight special, unnumbered pages. The typography and layout are both pleasing to the eye, and the binding is solid yet flexible enough to allow for easy opening and reading.

And this book does invite reading. The text is in an easy, personable, albeit British, style and is sure to delight both old and new magnoliaphiles — those whose interest is primarily horticultural as well as those whose interests lie in the taxonomy of the genus and the controversy surrounding specific boundaries, particularly in the *Oyama* and *Buergeria* sections of the genus.

Neil Treseder is to be congratulated on a beautiful book well produced and an information-filled, accurate text. My only concern is that the two maps which follow at the end of the book and purport to illustrate magnolia distribution in Asia and North America, respectively, are misleading inasmuch as the boundary lines of natural distribution have not been superimposed over the maps. Despite this one minor oversight, everyone interested in woody plants will want to own this book.

STEPHEN A. SPONGBERG

**The Miracle Houseplants: The Gesneriad Family.** Virginie F. and George A. Elbert. New York: Crown Publishers, Inc. 242 pages, illustrated with black and white and color photographs. Hardcover \$9.95; softbound \$6.95.

The Elberts, already known for their previous volumes and magazine articles on various aspects of indoor growing and for their involvement with the light gardening movement, have with this volume undertaken their first detailed study of a single plant family. It is not surprising that they should have chosen the Gesneriaceae for this effort, since the popularity of this group (which includes such important houseplants as the African violet, gloxinia, and streptocarpus) has been growing at almost epidemic speed and the last volume covering the family, published in 1967, has long been out-of-print. With such popularity, the number of species and cultivars introduced since 1967 has rendered the earlier volume quite incomplete, even if it were available. It is surprising, however, that the authors should have chosen this time to compile a study of the Gesneriads, since recent introductions and hybridizing efforts have led to considerable taxonomic revision, and a shifting about between genera which will, in all probability, continue for some time. The Elberts, in their somewhat grudging acknowledgement of these changes in nomenclature, and their caustic comments regarding the importance to the taxonomist of seeing his name in print, give this reviewer the distinct feeling that the answer may be quite simple: Whether Gesneriad nomenclature is, or will remain, current was not a priority; they knew the book would sell.

And sell it will! The Gesneriads have a loyal following that has been waiting for years for an up-to-date reference, and the book is designed to appeal to the collector of assorted houseplants as well. It is into this second category, in fact, that the Elberts themselves fall, although their collection has at one time or another contained an impressive percentage of the Gesneriads that are available in the United States. Their personal observations, to which they give free rein, may differ from those of the Gesneriad hobbyist, but will probably match those of the grower of a mixed collection; unless the Gesneriad in question will out-perform a non-Gesneriad, it is not worth the bother.

Although the major portion of the book (167 of the 224 pages of text) is devoted to an alphabetical survey of the genera, the Elberts have included brief but informative sections that cover the taxonomic characteristics differentiating the Gesneriads, their culture and propagation, a glossary of terms, and lists of suppliers of plants, seed and supplies. It is unfortunate that the addresses of the two national societies devoted to the Gesneriaceae are not included, since it is inevitable that readers of this book will be hungry for more information.

The Elberts' conversational style of writing makes this book a pleasure to read, despite one's occasional anger at the intrusion of their prejudices. As an introduction to the Gesneriaceae, this book will certainly interest many indoor gardeners and inspire them to experiment with some of the less common genera. The photographs alone should start a run on the specialist greenhouses. For the more advanced hobbyist, although the book leaves much to be desired, it will be a much-used reference.

JENNIFER HICKS

**Garden Conifers in Colour.** Brian and Valerie Proudly. Poole, Dorset, UK: Blandford Press. 216 pages, illustrated. \$5.95.

In the last seven years, at least four important books on identification and cultivation of conifers have appeared in Britain: *Conifers in the British Isles, A Descriptive Handbook* by A. F. Mitchell of the Forestry Service, *Conifers for Your Garden* by Adrian Bloom, *Ornamental Conifers* by Charles R. Harrison, and, now most recently, the present volume by Brian and Valerie Proudly. Mitchell's book contains practical descriptions by a foremost expert and unique information on the identification, location and welfare of major specimens in the British Isles. It is for the taxonomist and connoisseur, not the horticulturist. The Bloom and Harrison volumes both provide lists and colored photographs of the plants most suitable for horticultural purposes, and give valuable information on planting methods, nurturing, diseases, and landscaping principles. Bloom's is selective; Harrison's, comprehensive.

The Proudlys' volume is also primarily for the gardener. It contains colored photographs of selected samples only, and thus preserves comprehensiveness in a limited space. The authors have divided it roughly into thirds. The first section consists of definitions and landscaping and horticultural information. The second comprises 214 color photographs, and the third, brief descriptions of approximately 600 plants. The list was prepared by consulting "Nurserymen's catalogues from twenty-seven firms in ten different countries where conifers are grown."

Although the authors offer their many invaluable horticultural hints against the background of British growing conditions, this should not prevent American interpretations and applications. It is a surprisingly comprehensive book for one that fits in the coat pocket. Britain has provided the conifer enthusiast with yet another volume essential to his or her extending bookshelf.

RICHARD WARREN



A specimen of *Fagus sylvatica* "Tortuosa" in winter garb at the Arnold Arboretum.  
Photo: M. Dirr.

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# ARNOLDIA

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Cover: *Rhododendron obtusum*, from a glass plate in the Arnold Arboretum archives.

# Ailanthus

by SHIU YING HU

Ailanthus is called tree of heaven by some people. In its homeland, China, it is known as *Ch'un Shu*, pronounced almost like "train" and "sure" in English. Of all the trees introduced from China into American gardens, ailanthus is the most widely naturalized. The specimens in the Harvard University Herbaria indicate that the species *Ailanthus altissima* (Miller) Swingle runs wild from Massachusetts in the East to Oregon in the West, and from Toronto, Canada in North America to Tucuman, Argentina (and Buenos Aires, by reference) in South America.

In neglected areas of large cities such as Boston, ailanthus grows as trees close to buildings, as hedges, or as bushy aggregates along railroad tracks, highway embankments, walls at the ends of bridges and overpasses, or in cracks of sidewalks and along boundary fences between properties (Figs. 1-2). Around some dwellings the trees are so close to the windows that they prevent light and sunshine from penetrating the rooms, or they send roots to invade the sewers or damage the foundations.

Once ailanthus is established, it becomes very difficult to eradicate, for it can sprout from the stumps and on any portion of a root (Fig. 3, left); moreover, a female tree produces a large amount of winged fruits that spread and germinate in the gardens near, or even far away from, the mother plant. For these reasons, ailanthus has been maligned as a weedy tree by city dwellers. Lately, however, it has attracted the interest of environmentalists, and many of them have asked me questions about the tree both by telephone and in letters. This article contains a summary of the answers to some of the queries. It includes general characteristics of the species *Ailanthus altissima*, a history of its introduction from North China to Europe and thence to America, a review of its early uses in America, my observation of ailanthus in China and its position in Chinese culture, and finally comments on the future of ailanthus as a tree of economic importance in the United States of America.

This article is prepared for the information of the general public; specific material on taxonomy is not included. Phytogeographically the range of the genus *Ailanthus* is primarily Southeastern Asia and the Pacific Islands. *Ailanthus altissima* is the only species that can grow in the temperate or cold temperate regions.

In the transliteration of the Chinese names, the spelling is adopted from the Wade System of romanization as it appeared in Mathew's Chinese-English Dictionary, Harvard University, 1950 edition.

I should like to take this opportunity to express my appreciation to Dr. Lily M. Perry for sharing with me the information in her manuscript on medicinal plants of Asia, to Mr. Walter T. Kittredge for assistance with the illustrations, and to Mrs. Jeanne Wadleigh for many helpful suggestions.

### **Distinguishing Characters of *Ailanthus***

In order to have wise use of *ailanthus*, man must know the plant and be ready to pull the self-sown seedlings and the root sprouts as early as possible. Most people do not use a magnifying lens; without such aid, *ailanthus* may be recognized by its deciduous habit, smooth light ochraceous-gray trunk, stout branches, and reddish-brown, two- to four-year-old twigs with large heart-shaped leaf scars, each having many bundle scars along the margin and a roundish bud at the sinus. The leaf-bearing twigs are green with very short straight hairs. The leaves of *ailanthus* are odd-pinnately compound (Figs. 3-7), 20 to 60 cm. long, each with four to thirty-five leaflets. The petioles are terete, enlarged at the base and often tinged red above. The leaflets are ovate-lanceolate, rounded at the base, and each has two to four glandular teeth near the base. The leaves of root sprouts are yellowish-green when first emerging from the soil, and vary in size and number of divisions from unifoliolate to trifoliolate, penta-foliolate, or pinnately compound (Fig. 3, left). The leaves of a seedling are trifoliolate, crowded above the two rounded epigeal cotyledons (Fig. 3, right).

The flowers of *ailanthus* are small, yellowish-green, arranged in large panicles at the ends of new shoots, and they are sexually differentiated. A mature flower bud is roundish and small, about the size of a grain of green foxtail grass seed. The buds are borne on slender pedicels crowded in fascicles arranged on the secondary or tertiary axes, or even on finer divisions of the large panicle (Fig. 4). Normally, a male plant produces three or four times more flowers than a female plant. Naturally the male panicles are much larger than the female ones (Figs. 5-6). During the flowering season, the male flowers are more conspicuous than the female ones, and they emit an odor that attracts numerous insects. A flower of *ailanthus* has a very tiny cupular and lobed calyx, a corolla with five distinct petals that are hairy on the inside, and an annular and lobed gland. A male flower has spreading functional stamens, each with a globular fertile anther and a glandular cushion-like green disc. A female flower has ten (or rarely five by abortion) sterile stamens (staminodes), each with a heart-shaped abortive anther; a green glandular disc; and a pistil with five coherent carpels, a slender style, and a star-



*Fig. 1. Some self-sown ailanthus back of an apartment house on Commonwealth Avenue between Boston and Brookline, Massachusetts. A solitary tree growing in a limited space of a poorly lighted recess is twice as tall as those growing along the wall with more space and better light. The tall tree (left) has a bole 15 m. high and 45 cm. in diameter at breast height.*

like stigma. Soon after flowering, the carpels develop into five (or, due to abortion sometimes four, three, or even one) separate winged fruits (samaras, Figs. 4 and 6). These samaras mature greenish-yellow or reddish-brown, depending on the varieties. They persist on the branchlets even in winter. During the fruiting season, a female tree is more conspicuous in the landscape than is a male one. Due to the power of root-sprouting in *ailanthus*, one may find all the plants in an area producing male flowers, while those in another area all bear female flowers and fruit. The male plants of *ailanthus* do not bear fruit. I have not observed any female plants bearing flowers with fertile anthers. The condition described in most manuals as "polygamous" does not seem to exist in *ailanthus*.

The general characters given above are for normal plants. Abnormal growth conditions may alter some of the characters. First, repeated cuttings promote vegetative growth and inhibit flowering in *ailanthus*. Second, abnormal condition of the flowering of *ailanthus* may occur. This fact is substantiated by a collection of J. C. Nelson (2361) from Oregon. Evidently the specimens were gathered from a dying stump of a female plant. The sprouts are small and impoverished. The leaves have three to five leaflets only, and some of the terminal leaflets are lobed, rather than being divided to the base to form individual leaflets (Fig. 7). The flowers are in solitary fascicles or in small simple cymes in the axils of upper leaves. The abortive stamens are reduced in number, being five only, instead of the normal ten staminodes.

### The Introduction of *Ailanthus* to Europe

*Ailanthus* seed was first carried from Peking to Paris in a trans-continental trip via Siberia in the 1740's. The seed was collected and shipped from Peking by Pierre d'Incarville, a Jesuit priest who joined the China Mission in 1740 at the age of thirty-four. Incarville went to China not only as a mature person, but also as a very learned man who had received a botanical education from Bernard de Jussieu, Superintendent of the Jardin Royal des Plantes, Paris. According to E. Bretschneider, he was a Corresponding Member of the Academy of Science in Paris. He entered China via Macao, and traveled from South China to Peking in North China where he settled and died in 1756.

From 1743 onward, Incarville sent herbarium specimens and seeds to Jussieu. *Ailanthus altissima* and *Sophora japonica* are two of his introductions that have become well known in the American landscape. It must be remembered that in the middle eighteenth century, the botanical-minded individuals in Europe were interested in obtaining plants of economic importance in eastern Asia for introduction to their colonies of comparable climate in the Americas. In Incarville's trip from Macao to Peking, he had the opportunity to see the agricultural practices, and to learn about the plants of economic importance

from the subtropical region to the temperate region of China. When he was in the Lower Yangtze Region, he observed the Chinese varnish tree (*Rhus verniciflua*), apparently from a distance. After settling in Peking, he began to study the plants, collect specimens and seeds, and ship them to Paris. On seeing the ailanthus in Peking, he assumed it to be the varnish tree of the Yangtze Region, and sent the seed of ailanthus to Paris with a note about the lacquer tree. Although Incarville was not the first person who mistook ailanthus for a lacquer tree, his note became the source of confusion in the botanical literature in Europe for several decades. Before Incarville arrived in China, many Chinese scholars had recorded the difficulty in distinguishing the lacquer tree from ailanthus; for, as seen from a distance, the light ochraceous-gray trunks and the pinnately compound leaves of the two species are very similar. At the end of the sixteenth century, in *Pên-ts'ao kang-mu* Li recorded an ancient rhyme saying, "Ailanthus, planted or wild; And lacquer tree look alike."

On receiving the seed of ailanthus sent by Incarville, Bernard de Jussieu planted a portion of it in Paris, and sent some to England. Philip Miller, Superintendent of the Physic Garden at Chelsea, and Philip C. Webb, a man with a curious exotic garden in Busbridge, near London, both received some of the seed in 1751. According to W. J. Bean (*Trees and Shrubs Hardy in the British Isles* 1: 197. 1950), Peter Collinson also received some seed in the same year. This lot of seed was viable and produced young healthy trees well adapted for outdoor living in the climate of Paris and London. The seedlings grew beautifully under different names. In Paris they were recorded as *Rhus succedanea* L., or *grand vernis du Japon*; in Chelsea they were called *Toxicodendron altissima* Miller; and in Busbridge they were known as *Rhus Sinense foliis alatis*. Botanical literature of the middle 1750's recorded the dispute on the identity of their new introduction between Philip Miller and John Ellis, Superintendent of the garden of Philip Webb. These records have led to serious nomenclatural problems of *Ailanthus altissima* (Miller) Swingle.

On account of the rapid growth and the beautiful foliage of ailanthus, its popularity soared in Europe, and it soon became one of the most commonly planted and highly esteemed trees in European cities. In 1782, Friedrich Ehrhart visited Holland and saw a good-sized tree in Utrecht, and he named it *Rhus cacodendron* in a report.

In 1785, R. L. Desfontaines became Professor of Botany at the Jardin Royal des Plantes in Paris. Three years later, he observed the samara of the tree called *Rhus succedanea* L. in that garden, and he realized that it was not a sumac. In an article entitled "Mémoire sur un nouveau genre d'arbre, *Ailanthus glandulosa*," he published an illustrated description for the species (Fig. 4). He derived the generic epithet from a Moluccan name, *ailanto*, used by the island people of the Pacific for an evergreen species (*Ailanthus integrifolia* Lamk.) of the tropic forest. To these people, *ailanto* means "a tree of heaven." Desfontaines' name for ailanthus has been accepted widely, and it







appears in European botanical literature as late as 1957. However, by the International Code of Botanical Nomenclature, this epithet has to be disqualified as a valid scientific name for ailanthus because it is a later homonym at the species level.

In 1916, Walter T. Swingle, of the United States Department of Plant Industry, studied the history of ailanthus in Europe. He transferred to *Ailanthus* an earlier specific epithet given by Philip Miller and made a new combination to supply the correct scientific name for our common ailanthus, *A. altissima* (Miller) Swingle. Alfred Rehder in the *Bibliography of Cultivated Trees and Shrubs* listed fourteen synonyms for the species. Readers who are interested in this subject are advised to refer to both Swingle's and Rehder's work.

Genetically ailanthus is a polyploid ( $2n = 80$ ). Genetic segregation occurred in cultivation, and in Europe horticultural varieties were recognized in the 1890's. Leopold Dippel in 1892 described three varieties: *A. altissima* a. *rubra*, *A. altissima* b. *pendulifolia*, and *A. altissima* c. *aucubaefolia*. Rehder in 1949 treated the first two taxa as forms.

### Ailanthus in America

Ailanthus came to America via England. William Hamilton of Philadelphia was the first person who introduced ailanthus to his garden in 1784. The rapid and luxuriant growth of the plant and its power to thrive in unfavorable situations of poor soil and little care attracted the early settlers. In the 1820's the demand for small trees was handled by Prince and Parsons Nurseries of Flushing, Long Island, New York. Ailanthus was gradually planted in industrial centers such as New York City, Brooklyn, Baltimore, and Boston because of its ability to tolerate the dirt and smoke of cities. In the 1840's ailanthus was a common stock in the nurseries of eastern United States of America.

The specimens of Harvard University Herbaria and those of the New England Botanical Club bespeak the status of naturalization of ailanthus in the New World. As early as 1888, Curtiss reported that ailanthus ran wild in Virginia and the neighboring states. Freeman in 1955 reported that in Polk County of North Carolina, ailanthus was widespread, forming thickets, and had become a pest in some places. Anderson in 1961 reported that in Missouri, ailanthus was the prevailing tree from Kings Highway to the Mississippi River. During a recent trip to New York, I observed that numerous patches of ailanthus trees 3 to 7 m. tall occurred on the embankments of the expressway between Boston and New York, especially in the sections within ten to fifteen miles of these two cities. The frequency of the occurrence becomes greater as one nears the cities.

*Elements of Ailanthus in America:* More than one species of *Ailanthus* has been introduced into America. Alfred Rehder in the

Fig. 2. *Ailanthus* growing as weedy trees in the Allston section of Boston. a. A thicket-like stand of male ailanthus on a dump adjacent to a railroad at the junction of the Massachusetts Turnpike and Western Avenue, with tenements in the background; b. *Ailanthus* growing along a fence on Western Avenue where it passes over the Massachusetts Turnpike. The trees that have been cut repeatedly appear bushy.

second edition of the *Manual of Cultivated Trees and Shrubs Hardy in North America* included two species and three horticultural varieties of *Ailanthus*. The species are *A. altissima*, which is recognized by its smooth twigs and smaller fruits measuring 3 to 4 cm. in length; and *A. vilmoriniana*, which is distinguished by its prickly twigs and larger fruits measuring 5 to 5.5 cm. in length. The common ailanthus in cities and the naturalized trees all belong to *A. altissima*. In the Boston area this species has two forms; namely, *A. altissima* f. *altissima* with greenish-yellow fruits, and *A. altissima* f. *erythrocarpa* with reddish-yellow fruits.

*Objections to Planting Ailanthus:* In American horticultural literature, one may find several objections to using ailanthus for ornamental purposes. First, from the aesthetic point of view, some people dislike the massive clusters of shaggy fruits that remain on the leafless twigs in winter. Moreover, the self-sown plants often grow in unwanted places, and they are frequently harmful to neighboring objects such as living plants or constructions.

Second, to some people ailanthus is a generator of unpleasant odors because the leaves produce a foul smell when crushed. For this reason, the tree of heaven has been called the "stink tree." During the flowering season, the male trees emit an odor that is disagreeable to some people; near the flowers, it is barely detectable.

Third, there are charges that ailanthus is poisonous, and it is blamed for catarrhal troubles. Two cases of ailanthus poisoning were reported in *Garden and Forest*. The first case was reported by C. V. Tice in 1888. It concerned ailanthus fever contracted by a man in Boonsboro, Maryland, who suffered from sore throat, nausea, and inability to sleep at night for three weeks. The second case, reported by A. H. Curtiss, referred to a contact poison. A man cut down an ailanthus tree by trimming off the branches first; by night, his hands and face began to swell and his eyes were swollen shut. He suffered severely for several days. As no other cases were known, the editor of the journal commented that these criticisms of ailanthus were unfair. The man might have cut a poison sumac and misidentified it as an ailanthus, for without fruits as a guide, it would be difficult for a lay person to distinguish the two species.

*Afforestation with Ailanthus:* At first ailanthus was planted in America exclusively for ornamental purposes. Later it was used in some states for afforestation. Charles Sargent, the founder and first director of the Arnold Arboretum, was an advocate of this latter use. In the first issue of *Garden and Forest* he explained the merits of ailanthus, saying, ". . . for hardiness and rapidity of growth, for the power to adapt to the dirt and smoke, the dust and drought of cities, for the ability to thrive in the poorest soil, for beauty and for usefulness, this tree is one of the most useful which can be grown in this climate . . ." (*Gard. & For.* 1888: 380). Regarding the economic value of ailanthus, he pointed out that the species is a good source of



Fig. 3. Young *ailanthus*. Left: Sprouts from a rootlet 2 mm. in diameter. This rootlet is 5 m. away from the trunk of the mother plant. It emerges from a root extending from the base of the trunk to an island between the sidewalk and the street, sending branches upward to 2 cm. near the surface of the ground, and then produces three sprouts on a section 2 cm. long. The oldest sprout is nearer to the mother plant; the second one appears to have originated from a spot opposite the oldest sprout. The one on the right is the youngest. Apparently, soon after the sprouts could carry on the function of photosynthesis with their immature leaves, food material was stored in the cortex of that portion of the root between the three sprouts. Here the root is twice as thick as the sections before and after the emergence of sprouts. Photo: W. T. Kittredge.

firewood that has comparable heat-producing properties to those of white oak, black walnut, or birch. It burns steadily and slowly, giving a clear bright flame, leaving a good bed of coals, and finishing with a small amount of ash. For furniture, Sargent noted that the wood is "heavy, strong, it neither shrinks nor warps in seasoning . . . as material for cabinetmakers it has few superiors among woods grown in the temperate region. . . ."

Charles Koffer in 1895 reported that *ailanthus* was recommended almost without qualification for afforestation in Kansas. However, the species has proved to be unable to withstand the prolonged dry seasons on the high land in the Middle West. He also stated that *ailanthus* is profitable for the supply of fuel obtained when the trees are cut to the ground every few years, ". . . but in close plantation

it can hardly be grown as a timber-tree. . . . The species is too tender for northern Nebraska and the Dakotas. . . ." (*Gard. & For.* 8: 122-123).

In 1926 Illick and Brouse reported on the experiments of afforestation with ailanthus in Pennsylvania. They observed that as a forest tree, ailanthus is a fast grower, a persistent sprouter, and an aggressive competitor with the native species. The one-year-old seedling grows 1 to 2 meters tall; strong shoots sprout not only from the stumps, but also from any portion of the root; and the large amount of seed produced annually by mature trees and blown to the neighboring woods germinates. The progeny is difficult to eradicate. In this respect it is worthwhile to mention a report made in 1959 by François Mergen, of the School of Forestry, Yale University. Mergen found that an aqueous extract of ailanthus leaves contains a principle that is toxic to thirty-five species of gymnosperms including twenty-one pines, six spruces, five firs, a larch, a Douglas fir, and an arbor-vitae. Of the eleven species of native broad-leaved trees subjected to the experiment, only the white ash (*Fraxinus americanus* L.) was not affected adversely. Mergen suggested that a toxic leachate from the cuticular excretion of ailanthus leaves washed off by rain, produces a depressing effect on the growth of the neighboring plants.

Regarding the economic value of the product, Illick and Brouse reported that the fast-growing young ailanthus produces inferior wood that is brittle, non-durable, and easily split. The wood of old trees is comparable to that of ash or chestnut; it is moderately heavy, rather durable, difficult to split, and has a beautiful lustre. The sapwood is white-yellow, and the heartwood is grayish-orange. It does not shrink or warp in drying, and can be used for cabinet work, musical instruments, woodware, and charcoal. These authors further explored the possibility of making pulpwood of ailanthus and reported the findings of the Forest Products Laboratory of the USDA in Madison, Wisconsin. According to this report, the wood is well adapted for pulp, superior to the woods then used extensively in the United States for the purpose. The paper prepared from ailanthus pulpwood is good for books, lithography, and other purposes that require softness and opacity. It was noted that the wood of ailanthus must be harvested before the trees are thirty years old. As the plants grow to full size, they begin to deteriorate. The brittle branches break in strong winds and heavy snow, leaving deformed crowns. Moreover, a heart rot starts, and the trunk gradually becomes hollow. Then the tree falls in a storm.

### **Ailanthus in China**

Ailanthus has a different appearance in its homeland, China. As far as I know, there ailanthus appears neither bushy nor weedy. It rarely occurs within the city limits, but grows in villages or in the suburbs as isolated trees with straight, tall boles and rather flat

crowns. One may wonder why it is that the same species of tree behaves so differently in the two countries, China and the United States. The answer is an ethnobotanical one. The shape of a tree depends largely upon the man around it. In American cities where the self-sown plants of ailanthus are cut to the ground periodically by the workmen of the park department, they become bushy because of their ability to sprout from the stumps. In the neglected areas, the root sprouts of the established trees and their seeds develop into pure stands of thicket-like aggregations, partially because of the toxic leachate from the leaves that prevents the growth of other species. In China the situation is different. China is a densely populated country. As I have observed, fifty years ago nearly 90 percent of the population cooked with plant material, which included wood, straw, leaves of deciduous trees in North China, and dry manure of cattle in the nomadic areas. Under such conditions, children as well as adults gathered whatever combustible material they could obtain for fuel. No trees had a chance to grow unless they were wanted and protected by the owners. The wanted trees grown under protection were given proper care. Their lower branches were pruned at the proper time and the boles thus became straight until they were 15 or more meters tall. The unwanted self-sown young trees were exterminated by fuel gatherers. It is true that in comparison with the wood of a mature ailanthus tree, the heat-producing power of young trees and root sprouts is poor, yet they can provide a fuel better than leaves and straw.

*The Cultural Aspect of Ailanthus in China:* In China the history of *Ailanthus* is as old as the written language of the country. In *Erh-ya*, the first encyclopedia on the natural history and cultural objects in China, ailanthus appeared as the second name in a list of trees. Apparently the name used by the prehistorical ethnic groups existed in sound long before the development of writing. During the formative period of the written language of China, four ideograms with slightly varied pronunciations were created for ailanthus and recorded in the literature written before 100 B.C. In a *Materia Medica* compiled by imperial order in 656 A.D. (T'ang Dynasty) an ideogram consisting of the *mu* (wood) radical on the left and a *ch'un* (spring) sound on the right appeared in a pair with the *Erh-ya* ideogram. Since then, in Chinese botanical literature these two ideograms have been applied to ailanthus either together, or individually with one being listed as the synonym of the other. In the two most widely used botanical references, the authors did not agree in their choice of the ideograms. In 1937, Professor Chen in the *Illustrated Manual of Chinese Trees and Shrubs* chose the older *Erh-ya* ideogram for the genus *Ailanthus*. In the more recent work, *Iconographia Cormophytorum Sinicorum* (2: 561. 1970), published by the Science Press in Peking, the T'ang ideogram is chosen with a modifier. In this work *Ailanthus altissima* is called *ch'ou ch'un*



Fig. 4 (left). The first illustration of ailanthus with flowers and fruits (from Desfontaines, 1788.) Photo: W. T. Kittredge.



Fig. 5 (right). A specimen of ailanthus with a male panicle (E. E. Stanford 1488, California, May 16, 1930, Gray Herbarium.) Photo: W. T. Kittredge.

(stinking ch'un). The vernacular name in the Lower Yellow River Region for ailanthus is *ch'un-shu* (spring tree), a heritage the people received verbally from their ancestors since time immemorial.

There is an ethnobotanical reason why the prehistorical people of the Lower Yellow River Region called ailanthus the "spring tree" (*ch'un-shu*). It was not because they could detect the first sign of spring by the revival of life activities in ailanthus; it was an expression of release from severe cold and starvation. They observed that among all the deciduous trees of the area, ailanthus had the longest winter dormancy. They noticed that in the spring it remained leafless while the cottony seeds of willows were flying in the air, the coinlike samaras of the elms began to fall to the ground, and the food supply dwindled. To the people suffering from cold and starvation in semihibernation, the enlarged buds of ailanthus were an assurance of the return of the warm weather and a sign of hope for the approach of the next harvest season. Seeing the unfolding buds, the early people of North China exclaimed, "Oh, Spring is finally here!" That the rural people of North China link the enlarged buds of ailanthus with starvation is manifested in a nursery rhyme, "*ch'un-shu mao tsuan, o-ti ch'ung-jên fan po yen*" — "As the unfolding buds of ailanthus appear, the helpless white eyes of the starving people turn clear."

In Chinese botanical and pharmaceutical literature, *ch'un* is the basis of the common names of two trees. In addition to *ch'un-shu* for

ailanthus, it is also used for another species that resembles ailanthus in the pinnately compound leaves and in the delayed resumption of life activities in the spring. This species is *Toona sinensis* (A. Juss.) Roemer (better known in the United States as *Cedrela sinensis* A. Juss.). In North China, ailanthus grows spontaneously while cedrela is cultivated for its aromatic edible young shoots, used primarily as a spice. When the odors of the two species are compared, cedrela is called *hsiang-ch'un* (fragrant spring tree) and ailanthus is known as *ch'un-shu* in the villages, and *ch'ou ch'un* (stinking spring tree) in cities. In Li's *Pên-ts'ao kang-mu* and in some other Chinese *Materia Medica* published after this work, *hsiang-ch'un* and *ch'un* are discussed together, for both the leaves and the bark of the species are used in traditional Chinese medicine. Practitioners in China distinguish the products of the two species by smell and color. Accordingly, the products of *hsiang ch'un* smell pleasant and the bark appears dark brown with a reddish tint. In the market this bark is called *Hung-ch'un-p'i* (bark of red ch'un). The products of ailanthus smell foul, and the bark appears ochraceous-gray. The market product of ailanthus is called *ch'un-po-p'i* (white bark of ch'un).

In the literature of the Chinese people, ailanthus is expressed in two extreme metaphors: a mature tree refers to father, and a stump sprout indicates a spoiled youth. In writing letters between friends, *ch'un* (ailanthus) and *hsuan* (daylily) represent parents. When one expresses best wishes to a friend's father and mother in a letter, one writes *ch'un-hsüan ping-mou*, which may be translated literally as wishing that both your ailanthus and daylily are strong and happy. Ailanthus is chosen to represent the father for its magisterial posture as expressed by the straight, tall bole in a mature tree; daylily is used to refer to the mother because of the comforting and strengthening effect of mother love comparable to the function of *Hemerocallis* as a medicine, which "... benefits the mind and strengthens the will power, gives happiness, reduces worry . . ." (*Am. Hort. Mag.* 47(2): 53, 1968). When a disappointed father scolds a spoiled son, or a critical teacher writes about an irresponsible youth, he uses *ch'un-ts'ai*, which means literally "the good-for-nothing ailanthus stump sprout." Ailanthus stump sprout is used as a metaphor for a youth who is not bound to obligations. This is due to the writings of Chuang-tsu, a Taoist philosopher and writer of 300 B.C. who described a large tree with a crooked, enlarged base that produced wood unsuitable for the rulers and compasses of carpentry. Ancient scholars after him interpreted this to refer to ailanthus, and used it as a metaphor for delinquent youths who follow no rules and customs. They believed that a youth with such a beginning in life, like stump sprouts of ailanthus, will not develop into a useful mature person.

*The Economic Aspects of Ailanthus in China:* Ailanthus is grown in China for its wood, leaves, and the bark from root and stem.

1. The Use of Ailanthus Wood: The Lower Yellow River Region

has been a cradle of Chinese civilization and the seat of ancient Chinese history. There is hardly any natural vegetation left in this area, and few species of wood-producing trees. The common species are *Ailanthus altissima*, *Melia azedarach*, *Morus alba*, *Populus cathayana*, *P. tomentosa*, *Pyrus betulaefolia*, *Salix babylonica*, *Sophora japonica*, *Ulmus pumila*, and *U. parvifolia*. Among these species, *Ailanthus altissima* and *Sophora japonica* are the best producers of useful wood for all purposes. The rural people have a saying that the quality of the wood of an old ailanthus tree is comparable to that of *Sophora japonica*. In regard to the character of ailanthus wood, Y. Chen in the *Silviculture of Chinese Trees* (1933) reported that the wood is yellowish-white, lustrous, moderately hard, difficult to split, and has good flexibility. It is best fitted for the manufacture of steamers. (A steamer is a useful kitchen utensil essential for all types of Chinese cooking. The northern people depend upon it for steaming bread; and the southern people, for rice and various pastries. The sizes of steamers vary from 10 to 150 cm. in diameter, and the height has similar variations.) According to Y. Chen, Changhsin District (Long. 119°57' E, Lat. 31° N) in Chekiang Province of East China is famous for the production of steamer board from cultivated ailanthus.

2. The Use of Ailanthus Root for Mental Illness: This is one of the oldest recipes, first recorded in a *Materia Medica* published in 731 A.D. In those days, a psychologically unbalanced person was thought to be possessed by the demon. For a mentally dissociated person, gather a handful of fresh root. Cut the material into small pieces, and put it into 2 litres of urine gathered from young boys. Add 100 centilitres of *tou-shih* (material prepared from black soybean; cooked, fermented, salted, and treated with several herbal medicines; used as a health food and a spice, available in Chinese groceries in large American cities). Let the mixture stand overnight. Then press the liquid out, and bring it to a boil. Divide the liquid into three to five portions, and serve the patient one portion each day.

3. The Use of Ailanthus Leaves: In Chinese literature, reports were available on the use of ailanthus leaves for the silk industry in Shantung Province, and for medicine since the T'ang Dynasty.

For the production of Shantung or pongee silk, Y. Chen in 1933 gave this data. In Shantung Peninsula, particularly in Yen-tai (also known as Cheefoo, Long. 121°25' E, Lat. 37°30' N), ailanthus is cultivated for feeding the worms of a special kind of moth (*Attacus cynthia* Drury) for the production of "Shantung silk." This insect produces a kind of small ellipsoid cocoon pointed at both ends. The silk obtained from the unwound cocoons is coarse and durable. It does not take dye, and the fabric in natural color is commercially known as Shantung silk or pongee silk. The moth is big, grayish, with deeper color near the base of the wings, and with a crescent transparent spot and some reddish patches in the center of each wing. Professor C. E. Wood, Jr., of the Arnold Arboretum, has in-





Fig. 6 (left). A specimen of *ailanthus* showing a female panicle with a portion of young fruits added (A. H. Curtis), Virginia, June 1871, Gray Herbarium. Photo: W. T. Kittredge.

Fig. 7 (right). An abnormal condition of flowering in *ailanthus*, showing two sprouts from an impoverished stump with small fascicles or simple cymes of female flowers (J. C. Nelson 2361, Oregon, July 1918, Gray Herbarium). Photo: W. T. Kittredge.

formed me that, like *ailanthus*, the Shantung silk moth has been introduced into the United States and is naturalized in America.

*Ailanthus* leaf is also a Chinese herbal medicine. Li in *Pên-ts'ao kang-mu* summarized the history of its use and reported the properties accredited to the material. According to a *Materia Medica* compiled in T'ang Dynasty (ca. 684 A.D.), the leaves are slightly poisonous. When taken internally, they affect the nervous system, making a person sleepy and incoherent, with slow breath and weak pulse. For external uses, they are boiled in water to make a wash to cure skin ailments, especially boils, itches, and abscesses.

Li recorded a very interesting recipe for baldness. The tender young leaves of *ailanthus*, catalpa, and peach are pounded together. The juice squeezed off the crushed material is smeared over the bald area to stimulate hair growth.

4. The Use of *Ailanthus* Bark in Medicine: The dried bark of *Ailanthus altissima* is an officinal drug called *ch'un-po-p'i* (white bark of ch'un) (Fig. 8). The market product in drug stores consists of the barks of the root and the stem. In the new Chinese *Materia Medica* (*Chung Yao Chih* 3: 459-463. 1960), there is an illustrated account of the botanical description, centers of production, preparation, identification of the market product, medicinal properties,

chemical constituents, and pharmaceutical uses. Readers are advised to consult this reference for details. An abstract of the preparation of the drug, the appearance of the market product, and the chemical constituents is given here.

The tree is felled in spring or autumn when the bark has the highest amount of stored material. The bark is stripped, and the outer rough portion of each piece is scraped. It is then dried in the sun for the market. In retail drug shops, the dried bark is softened by briefly soaking it in water, then it is drained and covered in a basket to let the moisture permeate the interior. The softened pieces are sliced. The slices are dried and kept in a container for filling prescriptions. In traditional Chinese medicine, roasted *ch'un-po-p'i* may be called for. Such material is prepared by heating bran in a pan until it begins to smoke. The sliced or shredded bark is added to the hot bran and turned thoroughly. The mixture is taken off the pan and the bran sieved off; then it is cooled and kept for use.

In the market, the root bark appears like a piece of tile, flat or incurved, sometimes rolled into tubes, yellowish-brown, and tough. The sizes of the pieces are 3 to 10 cm. long, 1 to 5 cm. wide, 5 to 10 mm. thick; they are rough on the outside, smoother on the inside which is marked with punctiform or linear short elevations; the taste is bitter. The bark of the stem appears grayish ochraceous, irregular, and thicker than the root bark. The pieces are 1.5 to 2 cm. thick, and other characteristics are similar to those of the root bark (Fig. 8).

Practitioners of traditional Chinese medicine credit ailanthus bark with cooling and astringent properties, and regard it as beneficial for eliminating the physiological condition termed "damp-heat." It is prescribed primarily for dysentery, intestinal hemorrhage, menorrhagia, and spermatorrhea. The amount used in each prescription is relatively small, varying from 4.5 to 10 g. Patients without the symptoms of damp-heat, and those with stoppage in the excretory systems must not take ailanthus bark.

Li in *Pên-ts'ao kang-mu* recorded eighteen recipes with ailanthus bark for medicinal purposes. A few samples are selected and translated here. In the translation, the conversion of the ancient measurements of volume and weight was made with use of *A New English-Chinese Dictionary* published in 1975 by the Joint Publishing Company in Hong Kong.

For a mother who suffers from prolapse of the rectum after childbirth, put a handful of roasted bark of the branches of ailanthus in five litres of water and add five scallions with roots and a pinch of Szechuan pepper (*Zanthoxylon simulans*). Boil the mixture down to three-fifths of the original volume. Pour the liquid into a pan through a sieve and use it while hot to wash the troubled area. The liquid is good for five washes. It can be heated after it turns cold. The patient should lie down and rest after each wash.

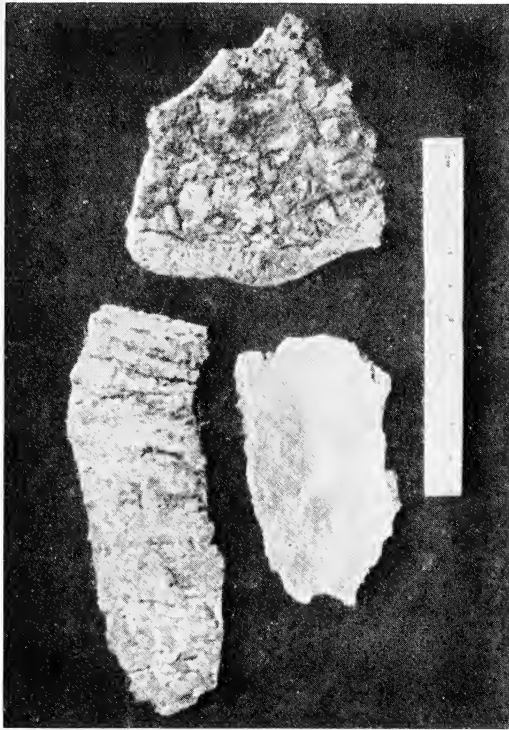


Fig. 8. Commercial products of *ailanthus* purchased from a drug store. The outer surface of the stem bark (top); root bark (lower left); inner surface of stem bark (lower right). From Chung Yüeh Chih photo 159, copied by W. T. Kittredge.

Almost 80% of the recipes Li recorded are for intestinal ailments. For a child suffering from diarrhea, pound *ailanthus* bark into fine powder, and mix with the soft portion (mesocarp) of the fruit of jujube (*Zizyphus jujuba*; a health food, available in Chinese groceries in America). Make balls of the size of a hazelnut, and expose them to the sun. Crush down the balls and mix the material thoroughly. Roll it into balls and expose them to the sun as before. Repeat the procedure three times. Feed the child seven pieces on an empty stomach. The diarrhea will be cured before he finishes seven doses.

For an adult who suffers from intermittent dysentery caused by *Entamoeba histolytica*, pulverize equal amounts by weight of *ailanthus* bark and the seed of myrobalan (*Terminala chebula*) with thirty cloves (*Syzygium aromaticum*). Make pea-sized pills with vinegar; take fifty pills each time with rice water.

For intestinal hemorrhage that lasts for months, use 6 g. of *ailanthus* bark and a cup of water. Boil the material until seven-tenths of the liquid is left in the container. Add one-fourth of a cup of gin and drink the mixture warm. If the patient is very weak, boil

the bark with 6 g. of ginseng and take the liquid mixed with gin in a similar manner.

The researches of phytochemists and pharmacologists in Asia and Europe have thrown some light on the scientific justification of the medicinal uses of the bark of ailanthus. An alphabetical list of chemical constituents isolated from ailanthus is given here: ailanthin, calcium oxalate crystals, ceryl alcohol, fatty acid, glyceryl trioleate, invert sugar, isoquercetin, mucilage, oleoresins, quassin, saponin, stearic acid, sterols, tannin.

5. The Use of Ailanthus Fruit in Medicine: The samaras of ailanthus are called *Feng yen ts'ao* (herbal phoenix eye) in the Chinese drug business. It is used as a hemostatic, for blood in the feces and urine, and for spermatorrhea. Recent clinical experiments proved its efficacy in the cure of trichomoniasis, a vaginal infection caused by *Trichomonas vaginalis*.

### Future of Ailanthus

The jigsaw pieces of information extracted from accumulated literature reveal the role of ailanthus in Asia, Europe, and America and provide us with some guidelines to evaluate it with respect to the welfare of mankind in the future.

In America, ailanthus has been grown for nearly two hundred years; first with enthusiastic praise, and then in undue neglect. Under such abnormal conditions, ailanthus has failed to offer the American people its best qualities. At one time, ailanthus was planted widely, sometimes in areas where it did not have the capacity to thrive. It failed in the afforestation of the plateaus and the high plains of the Great Plains region in the United States. By neglect it spread without check and became weedy in cities of the less dry areas of America. In 1961, Edgar Anderson used the phrase "Ailanthus . . . a blessing and a curse." It is true that through wise use ailanthus can be a blessing to the people, and by neglect it can be a curse. If American people want to have the benefit of ailanthus, they must be aware of its merits and shortcomings. Disciplined, ailanthus should be allowed to grow for it has much to contribute to the American people in our jet age.

*Ailanthus for Air Renewal:* Ailanthus is a tree with large compound leaves. The divided leaf blades provide the largest possible surface area for effective photosynthesis with oxygen as a by-product released into the atmosphere. American people need trees for the renewal of the air more than ever before, for the per-minute consumption of oxygen by cars and airplanes is hundreds to thousands of times more than such consumption by people. At a time when man has learned that trees are the most effective green plants for air renewal, wise use of ailanthus must be promoted.

*Ailanthus as an Energy Supply:* In an age when mankind everywhere is becoming increasingly concerned over the shortage of energy, people should take a fresh look at ailanthus. Its luxuriant, feathered foliage provides an effective agent for capturing the radiant energy of the sun and transforming it into chemical energy in the form of cellulose and other organic compounds. Its capacity for fast growth furnishes adequate space for storing this energy. The young plants grow unusually fast in height, and the older ones increase noticeably in girth. A thirty-year-old tree has a bole 10–15 meters high and a girth of 30–35 cm. in diameter at breast height; thus, the trunk and large branches are excellent organs for the storage of the chemical energy. They provide good sources of charcoal and firewood for supplementary house heating. Ailanthus should be considered equally with birch, white oak, and other species offering comparable heat-producing properties.

*Ailanthus for Clothing and Food:* The people of Shantung have demonstrated that ailanthus can be a source for the silk industry. Although the area of production of Shantung silk or pongee and the number of people involved in the industry are relatively limited, the product has a worldwide reputation. Before World War II, Shantung silk was available in large cities in Asia, America, and Europe. In Boston, members of the older generation praise it as a material for clothes and curtains. Fifty or sixty years ago, soybeans, like Shantung silk, were well-known products of China. Now, soybeans have become important products in the American economy and are exported from the United States. Many American soybean products are unfamiliar to the Chinese people. In the case of the soybean, the application of scientific principles in agriculture and the development of technology in America made the difference. Some investigators may find reward in research into the potentials of ailanthus as a source of silk for clothing and other domestic uses.

In 1944, Ronald Melville of the Royal Botanic Gardens, Kew, published an article on ailanthus as a source of honey. The owner of a Kensington apiary, A. Chesnikov, sent him a sample of honey for examination. It appeared pale greenish-brown and had a peculiar flavor that tasted like a mild floral bouquet with an aftertaste of "cats." On analysis, Melville found that the pollen constituents were 44% ailanthus, 26% chestnut, and 6% each of *Ligustrum* and *Tilia*. After the honey stood for a few months, the unfavorable taste disappeared, perhaps due to oxidative change, and the honey had a "delicious rich muscatel flavor." In 1945, C. Elton reported that on July 14, 1944, he observed thousands of hive-bees (*Apis mellifica*) visiting the male flowers of ailanthus at dawn. He saw no flies on the tree, "commonly associated with fly-pollinated flowers." Ailanthus can be a source of nature food, but the product must be kept for some time to let the flavor mature.

*Ailanthus and Industrial Potentials:* The Forest Products Laboratories of the United States Department of Agriculture have records on the physical properties of ailanthus wood pulp for the paper industry. The wood of mature ailanthus trees is of proven quality for cabinet work, musical instruments, and other types of wooden ware. Presently there is a need of breaking through the habit of using only certain woods, and the creation of market demand for the products made of ailanthus wood.

Like ailanthus, paulownia was introduced into eastern America for ornamental purposes. Its popularity vanished gradually and meanwhile it also became naturalized in eastern North America. Ten years after the publication of my monograph of paulownia, I heard from an Argentinian forester, Hector R. Mangieri, who had the vision of using paulownias for afforestation in that country. He put scientific principles into practice and prepared furniture and other articles for exhibition in the VII International Forestry Congress which took place in Argentina. Now, South American countries supply paulownia wood to Japan. In the United States, as in the case of paulownia, there are not enough large mature trees to supply any demand for ailanthus wood. In order to meet any future need of the wood, present planting of ailanthus is urgent.

*Ailanthus for Medicine:* An increasing impact of traditional Chinese medicine and pharmacy has been felt in the American medical profession and the pharmacological community. In the past few years, the Chinese Acupuncture Association, the American Center for Chinese Medicine, and the Institute for Advanced Research in Asian Science and Medicine (IARASM) have been organized in New York City and in Washington, D.C. In a recent letter from the Director of IARASM, I learned that the Institute is interested especially in information regarding Chinese medicine used as antihypertensive, antipsychotic, antihemorrhagic, antihyperglycemic, antibacterial, and anti-inflammatory agents. In traditional Chinese medicine, we have seen that ailanthus roots and leaves are used as antipsychotic agents, and in the treatment of dysentery and intestinal bleeding; ailanthus bark and fruits are used for antihemorrhagic, antibacterial, antiparasitic, and anti-inflammatory purposes. Unlike ginseng and many other adaptogenic Chinese herbal medicines which are used for keeping the body healthy and fit to fight the attack of disease germs, ailanthus leaves, roots, fruits, and bark are used for curative purposes. In comparison with other agents, the advantage of ailanthus is that the supplies can be obtained readily in large quantity and at reasonable price. There seems to be an open field for investigation in this area.

## Conclusion

In the struggle for survival with natural forces, the ancient people in the homeland of ailanthus have used it to meet their essential

needs for the construction of their primitive shelters and simple furniture, for a source of energy in cooking and heating, for the conservation of their mental health, and in the treatment of their physical ailments, particularly as a cure for various types of dysentery and intestinal hemorrhage. The species was first introduced to Paris under the assumption that it was the varnish tree. For almost thirty-five years, ailanthus was cultivated in Europe as a species of *Rhus*. There it was praised for its beautiful foliage and hardiness, and was used as a street tree.

Ailanthus was introduced from England to Philadelphia in 1784, and its popularity soared in the nineteenth century in America where it was widely planted for landscape purposes, especially in the industrialized cities in eastern United States. It was praised for its "power to adapt to the dirt and smoke, the dust and drought of cities." Now ailanthus is naturalized widely in the United States, and by neglect, it has become a weedy tree in cities, and even a pest in some areas. Many of our other street trees are weedy. The maples, horsechestnuts, elms, and ashes are the most obvious. We need trees in our landscape, and cannot abandon them merely because they scatter fruits or seeds that germinate freely in unwanted places such as our gardens and yards. At a time when man plants trees not only for ornamental purposes, but also for clean healthy air, for the transformation of the radiant energy of the sun into chemical energy stored in plants, for industrial raw material, and for natural drugs without harmful side effects, ailanthus deserves a new look; obviously, it has the potential to be effective in all these areas. Future investigations in ailanthus must be established on the foundation of past experiences and accumulated knowledge of the species. May the readers find the necessary foundation in this article, and more help in the bibliography listed below.

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# In Praise of Epimediums

by RICHARD E. WEAVER, JR.

The genus *Epimedium* consists of approximately twenty-five species of herbaceous perennials distributed primarily in China and Japan, but with a few in Europe, Asia Minor and North Africa. It is a member of the Barberry family, and its closest relative is *Vancouveria*, with three species on the West Coast of the United States. Their decorative foliage and odd but beautiful, softly colored flowers in the spring make the various species exceptionally fine plants for use as ground covers and as accent plants in the shady garden. The common name "Barrenwort," because decoctions of the roots of a plant confused with *E. alpinum* supposedly prevented conception in women, is seldom used in this country. I do not particularly care for it anyway, so I will call these plants by their Latin name.

Relatively few species are widely cultivated in the United States, and the nomenclature of these is badly confused, making it difficult to know what one will receive when ordering from most nurseries. One purpose of this article is to clarify the nomenclature and to provide a means for identifying the various species, hybrids and clones in cultivation. The nomenclature used, with a few exceptions, is based on Dr. William Stearn's monograph of the genus (*Journal of the Linnean Society, Botany*, Volume 51, pages 409-534, 1938); the observations are based on herbarium specimens and living plants in my garden. After the introductory material on culture and identification, the species that have been cultivated in this country are treated first, followed by a section on their hybrids. In each section, closely related species are grouped together for purposes of comparison.

Epimediums are adaptable plants in the garden, flourishing and flowering well in shade or sun. A good soil, rich in humus, is desirable. Their use in the garden depends on the species. Although often described as being good ground covers, only those few species that spread by elongate rhizomes are suitable for this purpose. The others do not spread sufficiently rapidly and are best grown as isolated clumps. Propagation is easily effected by division at most any time the ground is not frozen. I prefer to divide my plants before they flower in the spring or else in early summer after the foliage has fully matured. The resulting plants establish and flower more quickly than if they had been divided in the fall.

Dr. Stearn noted the scarcity of mature fruits on the cultivated specimens and attributed this to the possibility that the plants are basically self-sterile and that most species and hybrids are represented in cultivation by single clones. In self-sterile plants, two clones are necessary for pollination to be effective and for seeds to be formed. In my garden, where many species and hybrids grow in close proximity, seed set is generally good. I have experimented with seed germination without success so far, and I suspect that the seeds must be collected as soon as ripe and immediately given a cold stratification.

To assist in identification, I have prepared a key to the various species and their hybrids. But first, the characters used in the key need some explanation. The flowers are of rather curious construction, and the parts must be understood for positive identification of many species. All flower parts are in series of four. Starting at their attachment to the *pedicel* or flower stalk (the apparently uppermost parts since the flowers nod or droop) the *outer sepals* are small and inconspicuous and often fall off soon after the flowers open. The next ring, the *inner sepals*, are the most conspicuous parts of the flowers of most species. They would pass as petals to the casual observer, and they vary in color from pure white to reddish, purple, coppery and yellow. Next come the *petals*, and these vary greatly from species to species. In a few they are flat and resemble the inner sepals, but in most species they are modified into nectar-producing *spurs* or "horns," and these may be small and inconspicuous or they may be very showy, projecting far beyond the tips of the sepals. The entire petal may be spur-like, or the inner portion may be flattened, the bases of all four then forming a cup around the stamens. Figure 1 illustrates several representative flowers with the parts labeled.

The foliage of most species, at least in a climate like that of New England, is *deciduous* or *semi-evergreen*. In the latter case the leaves persist through the winter, but by spring they are brown and battered. A few species have truly *evergreen* foliage. The leaves are always compound. In some species, they are divided into three leaflets, a condition termed *ternate*. In others, each segment is again divided into three, resulting in a *biterminate* condition. The leaves are mostly *basal*, arising directly from the crown of the plant. A well defined group of species bears in addition a single leaf on the *flowering stem*. Several hybrids are variable in that they sometimes have a leaf on the flowering stem, while other flowering stems, or *scapes*, on the same plant are *naked*.

The leaflets are basically heart-shaped or somewhat triangular in outline, but the side pair in each group of three is *lopsided* or unequal at the base. They usually bear slender, often spiny-tipped *teeth* along their margins. Figure 2 illustrates the characters of the leaves.

All species spread by underground *rhizomes*. In most species the rhizomes are short and the plants are then densely clump-forming.

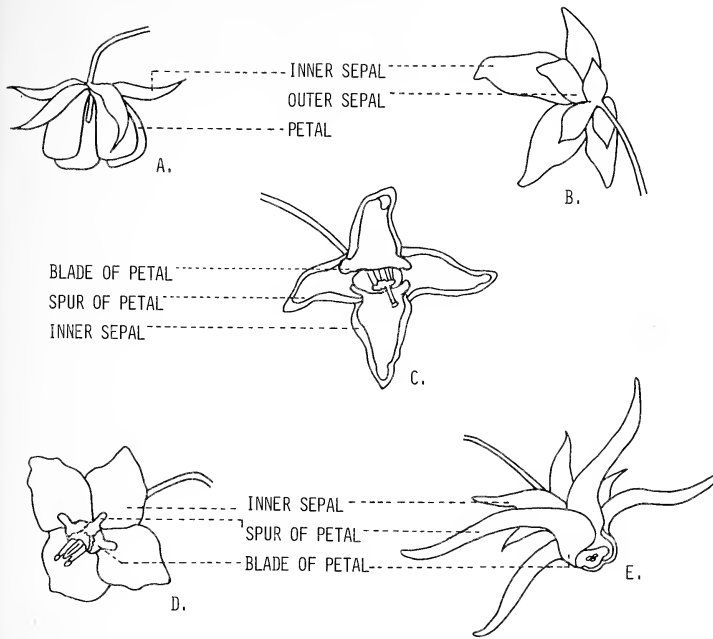


Figure 1. Flowers of *Epimedium* with the parts labeled. A, *E. diphyllum*, adapted from Curtis's Botanical Magazine, vol. 62, plate 3448, 1835; B, *E. x rubrum*, back view; C, *E. x rubrum*, front view, adapted from Curtis's Botanical Magazine, vol. 93, plate 5671, 1867; D, *E. pinnatum*, adapted from Curtis's Botanical Magazine, vol. 75, plate 4456, 1849; E, *E. grandiflorum*, adapted from Morrison & Decaisne, Annales des Sciences Naturelles, Paris, vol. 2, plate 13, 1834.



Figure 2. Characters of the leaves of *Epimedium*. A, a ternate leaf, showing the three leaflets with spiny-toothed margins; B, a biterminate leaf; C, the leaf of *E. diphyllum* showing the characteristic two leaflets without teeth on their margins; D, a plant with basal leaves as well as a single leaf on the flowering stem; E, a plant with only basal leaves and a naked (leafless) flowering stem. Both figures prepared by Sheila Geary.

A few have elongated rhizomes, and these spread to form a mat. The latter group are the most satisfactory ones for use as ground covers.

### KEY TO THE CULTIVATED SPECIES AND HYBRIDS OF *EPIMEDIUM*

1. Spurs of petals absent, or present in some flowers and not others; leaves with only two leaflets.
  2. Petals always spurless ..... *E. diphyllum*
  2. Petals with spurs present in some flowers ..... *E. × youngianum*
1. Spurs always present; leaves with three or more leaflets.
  3. Spurs of the petals nearly as long as, to much longer than, the sepals; bases of the petals forming a cup-like structure around the stamens.
    4. Flowering stem usually leafless; plants spreading by long rhizomes and forming mats ..... *E. × versicolor*
    4. Flowering stem with at least one leaf; plants densely clump-forming.
      5. Spurs of the petals reaching to the tips of the inner sepals.
        6. Inner sepals red; leaflets with numerous spiny teeth on margins ..... *E. × rubrum*
        6. Inner sepals white; leaflets with a few scattered teeth on margins ..... *E. × youngianum*
      5. Spurs of the petals projecting conspicuously beyond the tips of the inner sepals.
        7. Flowers creamy yellow ..... *E. koreanum*
        7. Flowers white to rose-colored or purple.
          8. Flowers pure white; leaves evergreen ..... *E. sempervirens*
          8. Flowers colored, the spurs sometimes white but the inner sepals always at least tinged with rose or purple; leaves deciduous ..... *E. grandiflorum*
    3. Spurs of the petals inconspicuous (at least much shorter than the inner sepals) or absent; bases of the petals not forming a cup-like structure around the stamens.
      9. Flowering stem leafless.
        10. Inner sepals coppery-orange in color .... *E. × warleyense*
        10. Inner sepals bright yellow.
          11. Leaves with 3 leaflets with distinctly spiny margins; spur of petal projecting away from sepal ..... *E. perralderianum*
          11. Leaves with 5-9 leaflets (rarely 3); leaflets nearly spineless or with inconspicuous, scarcely projecting spines; spur of petal lying flat against sepal ..... *E. pinnatum*
  9. Flowering stem with at least one leaf.
    12. Inner sepals coppery-orange in color .... *E. × warleyense*
    12. Inner sepals red, purple, pink or white.
      13. Sepals and petals similar in appearance and equally conspicuous, the petals sometimes spurless; mature leaflets less than an inch broad .... *E. × youngianum*
      13. Sepals and petals very different in appearance, the sepals by far the more conspicuous, the petals always reduced to small spurs; mature leaflets more than an inch broad.

14. Basal leaves with 3 leaflets; flowers tiny, scarcely 1/4 inch across ..... *E. sagittatum*
14. Basal leaves with more than 3 leaflets; flowers larger.
  15. Plants tightly clump-forming; leaves nearly evergreen; inner sepals pale rose or nearly white ..... *E. pubigerum*
  15. Plants spreading by long rhizomes, forming mats; leaves deciduous; inner sepals dark red ..... *E. alpinum*

### *Epimedium diphyllum*

A low, dainty and slow-spreading species, this would never do as a ground cover. Rather, it requires careful placement in the garden to avoid being lost. The uniformly white flowers differ from those of other species in that the petals are rather like the inner sepals in appearance, and they are completely spurless. They are small and delicate, and they are somewhat hidden by the foliage which is almost completely developed by flowering time in late May. The foliage itself is low, seldom more than 6 inches tall, and the leaves are made up of only two, small, scarcely toothed leaflets.

Originally introduced from its native Japan by Philippe Franz von Siebold, this species has never been as popular as *Epimedium* × *youngianum*, its hybrid with *E. grandiflorum*. Yet it is well worth a place in the garden, and I find it one of the loveliest of the species.





*Epimedium grandiflorum* 'Rose Queen'. Photo: R. Weaver.

### *Epimedium grandiflorum*

This widespread Japanese native is one of the most spectacular species of *Epimedium* in cultivation. It has given rise to a series of hybrids, which perhaps have overshadowed it in popularity, but the straight species and its various color forms are still worthy of a place in any garden. The most conspicuous parts of the flowers are the spurs of the petals which, in most forms, are nearly twice as long as the inner sepals. The flowers therefore have a spidery appearance, and they are often as much as an inch and a half broad. The inflorescences rise well above the leaves, to 8–10 inches or occasionally more, so the flowers are seen to their best advantage. Most clones flower at about the same time — from early to mid-May. The leaves are well developed at flowering time and they remain neat throughout the flowering season. The spiny-toothed leaflets are seldom more than an inch broad so the foliage is more delicate in texture than it is in species like *E. pinnatum*. Since it starts to wither soon after the first frost and is usually completely gone by spring, the foliage need not be clipped in the fall. Although perfectly hardy and excellent performers in the garden, plants of this species do not spread sufficiently vigorously to be useful as ground covers. How-

ever, because of their beautiful foliage and extremely unusual flowers, they are indispensable as accent plants or even as fillers in the shady border or the wild garden.

Several clones are common in cultivation, and all are often sold as clones or varieties of "*E. macranthum*." The wild plant has a relatively loose inflorescence and the flowers are bi-colored. The spurs are white, but the inner sepals as well as the blades of the petals are tinged with purple. The flowers are reportedly fragrant, but I have never been able to detect a scent in any *Epimedium*.

Like the typical plant described above, the clone 'Violaceum' was introduced into European gardens by von Siebold in the 1830's. This clone is distinctive in that its flowers are uniformly pale violet, and the spurs of the petals are only slightly longer than the inner sepals. This clone is rare in cultivation now, and I have never seen a plant.

The clone 'Rose Queen' is certainly among the showiest of epimediums. The large flowers are uniformly carmine-rose in color, except for the tips of the spurs which fade to white, and they are close together in the inflorescence. The color is unique to the genus and is very rare in the spring garden.

A pale yellow form, *flavescens*, has been described, but I have never seen a plant or an herbarium specimen (see *E. koreanum*).

### *Epimedium sempervirens*

This extremely fine plant is unfortunately still rare in cultivation in this country, and I know of no nursery here that currently offers it for sale. I received a plant of this species from its native Japan several years ago, and my personal experience is based on this rather small sample. *Epimedium sempervirens* is closely related to *E. grandiflorum*, and the flowers of the two species are similar in size and shape. However, my plant has pure white flowers, fitting Dr. Stearn's description of the species, while the flowers of *E. grandiflorum* always have some color at least in the inner sepals.

This species is one of the very few that is truly evergreen in this climate, a feature that further distinguishes it from *Epimedium grandiflorum*. The leaves retain their fresh texture, while turning an attractive bronzy-green, during the winter.

### *Epimedium koreanum*

Whether this is a distinct species or merely synonymous with the mysterious *Epimedium grandiflorum* forma *flavescens* is open to question. Besides its yellow color, it reportedly differs from *E. grandiflorum* in the larger size of the flowers and leaflets. I have a plant that I am calling *E. koreanum* for the present. I received it from a Japanese friend, and the species reportedly occurs in Japan as a wild plant. Its flowers are long-spurred and they are uniformly pale



*Epimedium sempervirens*. Photo: R. Weaver.

yellow. It looks very different from *E. grandiflorum* in the garden. The flowers are fewer per inflorescence and the leaflets are conspicuously larger. The latter are also much hairier on their under-surface. However, the status of *E. koreanum* as a species, and the true identity of my plant, will have to wait until more Korean material is available.

#### *Epimedium alpinum*

Described by Lindley (Botanical Register, volume 22, t. 43, 1849) as "the little dingy *Epimedium alpinum*, known only in the gardens of Botanists . . .", this species is seldom cultivated today and I have never encountered it in this country. It is a native of southeastern Europe, but it has become widely naturalized further north. Often standing 18 inches tall, with leaflets as much as 5 inches long, this is certainly not so delicate as many others of its genus. But I think that the quotation above is probably a bit unfair. Although I have never seen a living plant, the flowers look attractive enough from specimens. They are about  $\frac{1}{2}$  inch across, the inner sepals dark red, and the spurs bright yellow. Unfortunately, they are somewhat



obscured by the foliage. Since *E. alpinum* reportedly spreads vigorously by long rhizomes, it should be a good ground cover.

Plants sold in this country as *Epimedium alpinum* invariably prove to be *E. × rubrum*, its hybrid with *E. grandiflorum*. The two plants are similar in many respects, but the hybrid is a clump-former. It is horticulturally superior in its large flowers that are not obscured by the foliage. Technically the two are easily distinguishable. In *E. alpinum* the petals do not have a blade and therefore the stamens protrude conspicuously. The spurs are shorter than the inner sepals. In *E. × rubrum* the petals have a distinct blade, and the bases of all four form a cup to enclose the stamens. The spurs are pale cream rather than bright yellow, and they reach to the tips of the inner sepals.

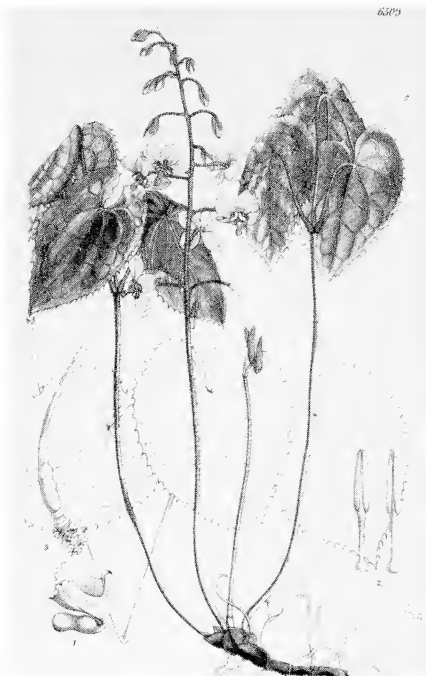
### *Epimedium pubigerum*

Although closely related to and sometimes confused with *Epimedium alpinum*, this native of the Balkan Peninsula is a much better garden plant. It is a clump-former, it is lower in stature, and its evergreen foliage is more refined. Its flowers stand well above the foliage, and even though they are small, they are profusely borne, and they are fascinating upon close inspection with their purple-spotted sepals and tiny spurs. This species appears to be rarely cultivated, even in Europe, and although I have seen herbarium specimens made from plants cultivated in this country, I have never seen a living plant, nor have I ever found it offered for sale.

### *Epimedium sagittatum*

This species was originally described from a specimen originating in Japan, where it has been cultivated for centuries as a medicinal plant. It is a native of China, and at present it is the only one of the many wonderful species from that country that appears to be in cultivation in the West. According to Dr. Stearn, the Chinese also have cultivated the plant as an aphrodisiac for both people and animals, in contrast to the European use of *Epimedium alpinum*.

The flowers of this species are the smallest of any of the cultivated epimediums, being barely ¼ inch across. They are also rather dull-colored, but they are abundantly produced in a tall, branched inflorescence. The foliage, however, is exceptional. It is the only species that I would term truly evergreen in my garden. The large, bold leaflets are of firm texture, and they bear on their margins numerous and conspicuous, spiny teeth; individual leaflets may be as much as 6 inches long. This clump-forming species is rare in cultivation, and I know of no American nurseryman who offers it for sale. It has not been vigorous in my garden, and it has yet to flower after two years.



*Epimedium pinnatum*

Native to the Transcaucasian region of Georgia (U.S.S.R.) and adjacent Iran, this is one of the best epimediums for use as a ground cover. It spreads vigorously by elongate rhizomes, forming a dense mat of attractive foliage about a foot tall. The foliage is almost evergreen, but by spring it is usually badly battered and tangled and it should be clipped to the ground before the new growth appears. The flowers appear with the foliage in early May on scapes that may be as much as 18 inches tall. This is one of the few species in which the flowering stem is leafless or naked. About  $\frac{3}{4}$  inch across, and up to twenty-five per inflorescence, the flowers are attractive and conspicuous. The inner sepals are large and bright yellow, and the minute spurred petals are brown.

The subspecies *colchicum* is the one usually encountered in cultivation. It differs from the typical plant in its longer spurred petals and its almost spineless leaflets. *Epimedium pinnatum* is not as good a garden plant as *E. × versicolor*, its hybrid with *E. grandiflorum*. The two are often confused in the trade; their differences are discussed later in the description of the hybrid.

*Epimedium perralderianum*

This species, native to the Atlas Mountains of Algeria, is one of the few African plants hardy in New England gardens. It is closely related and very similar to *Epimedium pinnatum*, and the two are nearly equivalent horticulturally. This species is slightly more desirable because its leaves are attractively marked with red while young. Technically the two species are distinguishable in that the leaflets of *E. perralderianum* are invariably three per leaf rather than five, and they are distinctly spiny-margined. In addition, the spurs of its petals project away from the inner sepals rather than lying flat against them as in *E. pinnatum*.

*Epimedium × youngianum*

The name *Epimedium × youngianum* is used for a series of clones thought to be hybrids between *E. diphyllum* and *E. grandiflorum*. The original plants were brought from Japan to Europe by von Siebold in the 1830's. Several clones are fairly common in American horticulture. *Epimedium × youngianum* 'Niveum' (often listed as "*E. niveum*," "*E. grandiflorum* var. *niveum*," or "*E. macranthum* var. *niveum*") is a delightful plant, seldom more than 8 inches tall in flower. It is similar to *E. diphyllum*, differing technically in that its leaves are usually composed of more than two leaflets, and that the flowers, even on the same plant, often have both spurred and spurless

*Illustrations of Epimedium species. Clockwise from top left, E. pinnatum, from Curtis's Botanical Magazine, volume 75, plate 4456, 1849; E. perralderianum, from Curtis's Botanical Magazine, volume 106, plate 6509, 1880; E. pubigerum, from Hooker's Icones Plantarum, volume 32, plate 3116, 1927; E. × rubrum, from Curtis's Botanical Magazine, volume 93, plate 5671, 1867.*



*Epimedium* × *youngianum*. Photo: R. Weaver.

petals. The spurs themselves vary in length and often are no more than bumps. Horticulturally it is superior to *E. diphylum* in that its larger flowers are held more nearly above the leaves and it has increased vigor. It usually ends the *Epimedium* season with a few sporadic flowers in June.

The other familiar clone, *Epimedium* × *youngianum* 'Roseum', is similar to the preceding except that the sepals and petals of its flowers are tinged with purple. Although the color is not bright, it is distinctive and attractive. It appears in the nursery trade under a variety of names, most commonly "*E. lilacinum*," "*E. macranthum* var. *lilacinum*" or "*E. diphylum* var. *roseum*." Plants of this clone bloom slightly earlier than do those of 'Niveum'.

Both of the above clones resemble *Epimedium diphylum* much more closely than their other parent, *E. grandiflorum*. However, I have seen a plant that appeared to be of this same parentage, but the pure white flowers closely resembled those of *E. grandiflorum* except that the spurs reached only to the tips of the inner sepals. Unfortunately the grower did not know the name nor the source of

the plant, and I have not found reference to anything resembling it. Further observation will be necessary before it can be identified with certainty and perhaps given a name.

The clones of *Epimedium*  $\times$  *youngianum* are very satisfactory garden plants. Their fine-textured foliage, low stature, and delicate flowers set them apart from others of their genus, and they require careful placement to prevent them from becoming lost.

### *Epimedium* $\times$ *versicolor*

To me these are the best epimediums for general garden purposes. The flowers are brightly colored, they appear with the developing foliage, and they continue to stand above it. The foliage itself is attractive through the growing season. The young leaflets are delicately marked with red, and as they mature they turn a good green and they are not coarse. The plants spread vigorously, but not invasively, by medium-long rhizomes so they make a good ground cover 10–12 inches tall that is dense enough to discourage weeds. The one drawback is that the foliage is neither evergreen nor deciduous; rather it persists through the winter in a bedraggled state and remains intact enough to obscure the developing flowers in the spring. Therefore it is best clipped to the ground at the onset of winter.

The name *Epimedium*  $\times$  *versicolor* denotes a series of hybrids between the Japanese *E. grandiflorum* and the Caucasian *E. pinnatum*. They are obviously of garden origin, but the specifics as to the time and place are unknown. They are closest to *E. pinnatum*, but their foliage is not nearly so coarse. Their flowers are similar to those of that species at a glance, but the petals with their conspicuous spurs standing away from the sepals, as well as their well developed blades enclosing the stamens, easily identify the hybrid upon closer inspection.

Several clones are in cultivation. By far the commonest is *Epimedium*  $\times$  *versicolor* 'Sulphureum' (often listed as "*E. sulphureum*" or "*E. pinnatum* var. *sulphureum*"). If I could grow only one epimedium it would be this one. The flowers, ten to twenty nodding delicately above the foliage, with their pale yellow sepals and butter-yellow spurred petals, are the epitome of graceful beauty. They appear at the same time as those of the biennial forget-me-nots and the grape hyacinths, and a planting of the three is one of my favorite springtime pictures.

The clone 'Versicolor' is similar to the above except that the sepals are an "old rose" color and the petals are pale yellow. Since I know of only one nursery in the United States that lists this clone, and I only have had my plant for a single season, I will reserve comment. The clones 'Neo-sulphureum', with shorter spurs, and 'Cupreum', with coppery-red sepals, unfortunately are unknown to me.

*Epimedium*  $\times$  *rubrum*

All of the epimediums have their unique charm, but this one has enough attributes to make it draw comment from even the beginning gardener. It is surely the most floriferous of all, and a well established clump in full bloom in early May is a stunning sight. If not crowded, the countless inflorescences form a complete halo around the center of spring-green foliage; this in itself, a picture with each delicate leaflet edged and veined with red.

This is perhaps the most commonly cultivated of the epimediums, and it is a fine plant. It is without doubt a hybrid between the Japanese *E. grandiflorum* and the European *E. alpinum*. It obviously arose in some European garden, but its origin is unrecorded. It entered the gardening literature around 1844. In many ways it closely resembles its *E. alpinum* parent, and it is almost invariably sold and described as *E. alpinum* var. *rubrum*. It is a rather tall epimedium, the inflorescence often reaching a foot or more. The numerous flowers are about  $\frac{3}{4}$  inch across. The sepals are a soft rose-red, the dominant color from above; to appreciate their complete beauty, one must separate a flower. The cream-colored spurs, lying close against the sepals, form a perfect cross accented in the center with the bright yellow anthers peeking through the cup formed by the bases of the blades of the petals.





Left: *Epimedium* × *versicolor* 'Sulphureum'  
Above: *E.* × *warleyense*. Photos: R. Weaver.



This plant is usually sold as a ground cover, and it could be serviceable as such in a small area. The foot-tall foliage, though deciduous, is unusually delicate and attractive. But the plant is a clump-former, and to be effective as a ground cover, the clumps should not be more than 10–12 inches apart initially. If used in this way, the flowers will not be profuse.

*Epimedium* × *warleyense*

This is the only commonly cultivated hybrid *Epimedium* that does not have *E. grandiflorum* in its ancestry. Rather, it is thought to be a hybrid between *E. alpinum* and *E. pinnatum*, but its actual origin is unknown. It is a striking plant, and one that always causes comment in my garden. The flowers are borne on 8–12-inch stalks in late April or early May, before the leaves are well developed. They resemble those of *E. pinnatum* closely, but they are slightly smaller, the sepals are coppery-orange and the spurs are bright yellow.

Although a strongly rhizomatous plant, it cannot be recommended as a ground cover because the foliage is a bit coarse and appears from the ground too irregularly, making the cover sparse and uneven. However it is a fine plant for the wild garden, sending up its beautiful flowers here and there, but not becoming dense enough to choke out more delicate wildflowers.

In conclusion, I would like to make a few remarks about what we can expect in the future in the way of new epimediums. Many wonderful species are native to China, ranging from *Epimedium acuminatum* and its allies with large, long-spurred flowers, to *E. fargesii* with its cloud of tiny blossoms, each one with the sepals reflexed suggesting a *Cyclamen*. We can only hope that some of these will eventually reach Western gardens.

A few Japanese species are still unknown in the West, but these differ only slightly from commonly cultivated plants. *Epimedium trifoliatobinatum* differs from *E. grandiflorum* primarily in its foliage, but *E. setosum* might be better than its close relative, *E. diphyllum*, because of its branched inflorescence with more flowers. However, the Japanese have selected particularly good forms of *E. grandiflorum* that are gradually making their way to this country.

Finally, no exciting new hybrid has appeared in more than a century. With so many species now in cultivation, the possibilities are fantastic. I would suspect that it is possible to cross *Epimedium* with *Vancouveria* and perhaps even *Caulophyllum*, adding a whole new dimension.



## NOTES FROM THE ARNOLD ARBORETUM

### *A Message from the New Director*

My family and I shared your frustration at the unexpected three-month delay in our arrival, due to immigration clearance. After all the waiting we were truly overwhelmed by the warmth of the welcome we received. We appreciate and return these greetings and look forward to sharing the years ahead with all of you. I am stimulated and encouraged already by the spirit of enthusiastic and amicable collaboration with which we are setting about the tasks to be accomplished.

Fortunately, our future course will be built on the firm foundation laid by my predecessor, Dr. Richard Alden Howard, who devoted nearly twenty-five years of his life to our institution and guided it skillfully through challenging times; what future success we may have will, in part, be thanks to him.

Charles Sprague Sargent and his successors have established an international reputation for our Arboretum, and it is our intention to see that it gains still further prestige. The Arnold Arboretum remains a unique facility: it is in effect a museum and perhaps comprises the most extensive living collection of woody plants in North America. This great collection gains further distinction from having been planned as a landscape garden which forms an integral part of the planned park system of a major city. However, it does not serve merely as a plant collection of high horticultural merit and a fine public amenity; it has an international reputation as a university institution for research and education.

I believe our future success must lie largely in harmonizing those apparently disparate functions. To this end, I shall need, and wish particularly to request, the advice and help of all our friends who read this journal. I cannot pretend to have your experience, and I therefore shall depend on it for insuring the continuity of policy that is so essential to the well-being of a great collection of living trees. Although we shall need, and I intend, to innovate, we also must work together to avoid hasty and counterproductive change. I intend to succor a spirit of partnership, a friendly collaboration between pure and applied scientists and members of the public, in shaping the future of our Arboretum. It is in this spirit that I present the

following ideas, which I have been developing since my appointment, in the hope of eliciting your comments.

There are several arboreta of comparable size and reputation to the Arnold, but none, as far as I am aware, possesses the very considerable advantage of being a university institution. We have, perhaps, thought of the herbarium as our principal center of research, but we must not underrate the research potential offered by the living collections and Dana Greenhouses at Jamaica Plain, and the collections at Case Estates. Opportunities exist here for basic research to bridge the traditional divisions between biology, horticulture and forestry. As an example, our staff members are doing valuable work already in the difficult field of woody plant propagation; nevertheless, many of the scientific ground rules, of adventitious root initiation or tissue culture for instance, have yet to be defined. The Arboretum should seize the opportunity to become a leader in such research, with the aim of providing the foundations upon which horticulturists and foresters can build.

Our herbaria will maintain, and with the new building extension can expand further, their preeminence in systematics, but the Arboretum should play a greater part as well: chemistry, for instance, is aiding increasingly in taxonomy and phylogenetics. Electrophoretic analysis of enzyme systems is useful in the study of population genetics and evolution. Research into the chemical reasons why many herbivorous insects are so specific in their food sources is increasing our understanding of natural selection in forest ecosystems. Such research requires easy access to living material for development of the often intricate techniques required; the Arboretum can provide this material. The living collections offer a host of other opportunities for both research and instruction in reproductive biology, phenology, anatomy and morphology, tree architecture, leaf and canopy structure, and environmental physiology, the results of which can have important implications in horticulture and forestry.

In summary, the Arboretum should act not only as a natural extension to the herbarium for the taxonomist, but give scientists the opportunity to return time and time again to the living material as knowledge and technology expand and our perception of the major problems in science changes. This is particularly valuable for those species, of which we have many, that have been brought from remote and inaccessible forests, or from the many regions of the world that are now deforested.

The Case Estates can provide excellent and convenient facilities for experimental culture. There would appear to be plenty of opportunity for expansion of demand, and I would welcome use by Boston area universities other than Harvard.

The Arnold Arboretum was established, as we all know, to grow "all the trees, shrubs and herbaceous plants, either indigenous or exotic, which can be raised in the open air at . . . West Roxbury."

As a natural extension, we are particularly well placed to contribute to the study of the rich woodland flora of New England. It is my hope that this may be sustained and expanded through our long-standing links with the New England Botanical Club. Club members, as well as schools and the public at large, can play a major part in the exploration and recording of the woodland flora. Such work is vital, not only as a record for the future, but as a base for future planning in our rapidly changing environment.

Again, as Sargent and his colleagues Wilson and Rock were to show us, our climate and flora have much in common with that of parts of East Asia. This allowed the Arboretum to play a commanding role in the botanical exploration of that region, and through its expeditions hundreds of new species were brought into cultivation in North America and Europe. Our staff members are exploring this region once again. Although there are certainly further species to be discovered and introduced, I believe an equally important role for us is in research and instruction in aspects of dendrology common to regions that share our climate. It is heartening news that soon we may welcome again graduate students from China for this will enable us to reestablish old and cherished links.

Currently, I serve on a National Academy of Sciences committee that is under the chairmanship of Dr. Peter Raven, present chairman of our Visiting Committee, and is charged to establish research priorities in tropical biology. Forests, extraordinarily rich in species, are being felled for timber and for agriculture so rapidly that they are expected to be reduced to fragments by the end of the century. This scale of destruction is unprecedented anywhere, but that it should happen to vegetation of such outstanding biological interest is a catastrophe in itself, laying aside the narrower implications for our own species. The Arnold Arboretum, notably under Director Elmer Drew Merrill, long ago extended its Asian interests to include the tropics of the Far East. As a consequence we have at Cambridge the best Far Eastern herbarium in the United States. We are, therefore, the natural center for Far Eastern botanical research in this country. As you may know, my own research has been pursued in that region. I am sure that renewed interest by the Arboretum will be welcomed by my colleagues in Asia. Their research goals will inevitably be more local and immediate than ours, concentrating, for example, in floristic research for preparation of foresters' manuals of timber trees, and in the improvement of silvicultural techniques. We are qualified to collaborate in both these fields. Manuals on tree identification must be based on a stable nomenclature, which our taxonomists can provide through monographic research; partnership in field work will facilitate deeper biological understanding and enable our staff, and hopefully students, to pursue specific topics of rain forest research. Further, perhaps the most serious impediment to the management of Far Eastern rain forests as a continuing source

of hardwoods is the absence of successful practical techniques for propagating and transplanting young stock of their leading timber family, Dipterocarpaceae, which provides us with Philippine mahogany. Basic research into tree propagation could thereby contribute to the rehabilitation of this resource.

I do not believe that the expanded use of the living collections for research is in conflict with their role in the general service of the community — as an amenity and as an integral part of Frederick Olmsted's scheme of green ways and parks that contribute so much to Boston's character. I shall be seeking means to enhance this amenity value: ways will be found to improve further the appearance of the Arboretum, and thus to give cause to the public at large for increasing pride in it. I hope in particular to encourage greater participation in field classes and also in collaborative volunteer projects with schools, especially those that serve neighboring districts. We can thereby seek to establish bonds of interest and sympathy among the young that will last and be passed on.

I believe that a new impetus, a new reaching out to our neighbors, will by itself reduce the vandalism that has plagued the Arboretum for so long. Our problems of security are common to all urban parks; but it must be admitted that currently they detract seriously from the amenity value of the Arboretum and preclude conduct of scientific research on the living collections. I recognize, therefore, that improvement of security is the first task ahead of me, for much that I have spoken of cannot be realized without it.

You will feel that I should not be so ambitious! Why not? Your views and alternative suggestions will be appreciated; the omens are good, and we should seize the chances while they are available. I hope that I have conveyed to you something of the excitement I feel for this great institution; together we can bring some of these hopes to reality.

PETER SHAW ASHTON

## **ARNOLDIA REVIEWS**

**Wildflowers of the Southeastern United States.** Wilbur H. Duncan and Leonard E. Foote. Athens, Ga.: University of Georgia Press. 296 pages, illustrated. \$12.00.

For this volume, the southeastern United States is defined to include Delaware, Maryland, West Virginia, Kentucky, Arkansas and Louisiana south and east. Plates, usually of four very high quality colored illustrations, oppose pages of descriptions of the plants considered. The arrangement is by family groups and these are in the Englerian system with the Monocotyledoneae at the end. Descriptions are brief and non-technical, and casual comments on ecology, distribution and uses are given. Scientific and common names are combined in one index. Introductory material explains in a glossary and by illustrations the botanical terms used in the text. There are no keys.

This is a most attractive book of handy size that will please those persons using it for recognition of the common wild flowers of the southeastern states.

RICHARD A. HOWARD

**Heathers in Colour.** Brian and Valerie Proudley. London: Blandford Press. 192 pages, numerous color illustrations. \$5.95.

This small but comprehensive book is another of the excellent Blandford Colour Series. Every aspect of growing heathers is covered, from possible uses through cultivation instructions and suggested color groupings to propagation methods.

The sixty-four pages of color photographs of both individual plants and established gardens are exceptionally fine and should prove extremely useful to any gardener wishing to invest in these lovely shrubs.

The last third of the volume lists ericas, callunas and daboecias and their many cultivars, giving detailed descriptions of color, time of flowering and cultural requirements.

This is a splendid reference book for English gardeners, but of only limited value to their American counterparts, as many of the varieties listed would not be hardy here, and there is no indication in the text as to which plants might withstand the vagaries of our climate.

CORA WARREN

**Starting from Scratch: A Guide to Indoor Gardening.** John Whitman. New York: Quadrangle. The New York Times Book Company. 211 pages, occasional line drawings. \$8.95.

The author is a freelance writer and this volume is written to be a moneymaker in the current market of romanticists who want to be horticulturally creative. Fundamentally, it instructs the novice how to sprout and grow on exotic garbage — seeds from mangoes, papayas, pineapples, loquats . . . as well as more mundane herbs, while giving very useful information about propagation adapted to several levels of proficiency. Unfortunately, most of the would-be grower's exertions will be a waste. Should he succeed (doubtful) in developing a single sugar cane indoors, he will have merely a rather withered, ungainly 3-foot grass plant.

The deplorable tendency of amateurs to sprout avocados and produce "conversation-pieces" is, in the reviewer's estimation, a trend to be discouraged. This volume capitalizes heavily on the avocado-growing im-

pulse. Who has seen the finest home-grown avocado that was not out-classed by any ficus? However, if you still would grow your very own kiwi vine, this is the book to tell you how!

ELINORE B. TROWBRIDGE

**Woody Vines of the Southeastern United States.** Wilbur H. Duncan. Athens, Ga.: University of Georgia Press. 76 pages, illustrated. Paperback \$2.50.

This work was originally published in *Sida*, and was reprinted in paperback when the supply of reprints was exhausted. The area covered is comparable to that of *Wildflowers of the Southeastern United States*. A key to the genera of vines is followed with keys to species in larger genera, line drawings of the plants, and distribution maps. The personal observations on many of the taxa add significance to the booklet's use for identification.

RICHARD A. HOWARD

**The Treasury of Houseplants.** Rob Herwig and Margo Schubert. New York: Macmillan Publishing Co., Inc. 368 pages, color illustrations. \$12.95.

Originally written for the European market and now published in this country, this guide commences with an interesting and comprehensible exposition of how plants grow. Basic propagation methods are well described and illustrated by line drawings, and there is a useful taxonomic section. The authors also deal with the siting of plants from the viewpoints of their health and aesthetics in house or office; there even is a unique discussion of heirloom plants.

The fine basic material is followed by descriptions of more than 1,000 houseplants of all categories, arranged alphabetically by botanical name. History, habitat, culture and propagation are covered; if there are special problems, these are remarked. Numerous excellent photographs augment the text, accurately depicting plant habit as well as coloring.

Total format, paper, typography, color reproduction, and quality of the text all contribute to making this guide an outstanding value for the novice while giving no offense to the most learned taxonomist.

ELINORE B. TROWBRIDGE

**Echeverias.** L. Carruthers and R. Ginns. New York: Arco Publishing Company, Inc. 110 pages, illustrated. \$7.95.

The authors have been collecting and growing *Echeverias* for twenty years and in this non-botanical book they describe more than one hundred species and hybrids that they are currently growing in their own collections in England. The major portion of the book is given to the descriptive lists, along with numerous black and white line drawings and twenty-four pages of beautiful color plates. There also are chapters on their culture, which is simple, problems, which are few, and a short but fascinating history of the establishment and introduction of the genus into cultivation.

This is an excellent book for the beginning or advanced collector and should help to revive some interest in this once popular genus.

SHELIA MAGULLION



*Carya sp.* Photo: P. Chvany

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# ARNOLDIA

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# Street Trees

## *for Home and Municipal Landscapes*

by GARY L. KOLLER and MICHAEL A. DIRR

Worldwide, cities and most towns have one element in common: the seemingly endless ribbon of highways that cut through the countryside like great scars, often reflecting a reckless insensitivity to the natural landscape. It is in cities, however, where they make their greatest visual and physical impact. Streets lie flush with sidewalks and these, in turn, give way to great buildings. Grass and other vegetation is little in evidence. Beyond, in suburbia, the scene is less stark as the ribbon winds through residential areas with their ubiquitous 50- by 50-foot lots; but still the sidewalks, driveways and roadways are the dominant features of a society on the move.

Into this landscape, the eyesores of service stations, fast-food establishments and mushrooming shopping centers must be included. Neon signs and billboards compete for the consumer's attention, manufacturing plants spew black and acrid smoke across the skies, and dumps, junkyards and salvage shops display the detritus of a "throwaway" society. Interspersed, of course, are majestic churches, historical structures with delicate and handsome details, and buildings both modest and monumental that are architectural treasures. All of these disparate features blend in a confusing montage with little to separate, frame, or soften the overall impact and bring it into human scale and human terms.

Plants have a great deal to contribute to the city landscape, but often have been overlooked because urban space is at a premium and their maintenance is an additional expense that most businesses and city agencies do not choose to assume. Because of budget limitations, the landscaping of a building is often the first item to be sacrificed when money runs out. As a result, many spaces that would be enhanced by greenery are paved instead.

Nonetheless, we notice those city areas where plants have been used effectively and have seen people stop to admire or pause to enjoy the attractive visual environment in which they have suddenly found themselves. Street trees, more than shrubs, have the greatest capacity to make a visual impact, and require the least amount of horizontal ground space. They develop into green walls or buffers that soften the lines and angles of manmade structures; create canopies under which people can walk; cast shade to reduce reflected heat and light; and trap airborne dust particles, filtering the air we breathe. Equally important, they stand as silent

sentinels, providing us with a direct link to the green world we have so often sacrificed in our attempt to "progress."

The term 'street tree' can be interpreted in several ways. Most commonly it refers to those trees planted in a narrow tree lawn (illustrated) running between street and sidewalk and evident in urban, suburban and some rural locations. It also includes those trees planted in islands within parking lots or between roadways, in small spaces cut out of the sidewalk, plants in above-ground streetside containers and trees planted along expressways and superhighways.

Street trees reside in situations that vary from high impact areas such as midtown Manhattan, to placid hamlets in Vermont where a street tree is essentially in open countryside. While each of these uses and locations presents different landscape design opportunities, each imposes trials and tribulations that affect the health, well-being and life span of trees.

Consider the stresses to which the average urban and suburban street trees are subjected. In the confined growing space, soil is not only limited, but is often dry, rocky, infertile and compacted. In summer, desiccating winds, reflected heat, and sunlight increase transpiration, resulting in wilting and scorched leaves. Drainage water and pollution (specifically, ozone and sulfur dioxide) often disrupt metabolic activities.



*In this situation, Bradford pear is successfully used as a suburban street tree. Note the wide planting area between the street and sidewalk: such space seldom occurs along urban streets.*

Winter hazards include cold, drying winds intensified by the tunnel effect caused by buildings. Salt spray from deicing operations bathes stems, buds and the leaves of evergreens, while salt-laden water drenches the soil around the roots.

Along with the pressures of the physical environment, the plant must survive neglect, vandalism, trenching and building operations, vehicular damage, and the public's widespread insensitivity to the tree as a living organism.

Because of these limiting factors, the ideal street tree remains undiscovered. No one plant is perfect, and the same plant may not be ideal under two different situations; further, each plant is asked to serve a multitude of different landscape purposes.

In view of the vicissitudes that street trees must withstand, what would constitute the ideal street tree? It should be a vigorous grower, yet one that does not create a maintenance problem because of rapid growth and weak wood. Annual care such as pruning, spraying and leaf removal should not be needed. A desirable feature is the capacity to grow in a limited volume of dry, sterile, rocky soil. The tree should tolerate drought, drying winds, and intense reflected sunlight without becoming brown or scorched. Dust, smoke, soot and noxious fumes should have little or no effect. Tolerance to the winter hazards of salt spray, salt-laden drainage water, and oil and gasoline is necessary, as is the ability to recover quickly from mechanical injuries caused by vandalism and snow removal equipment. The plant should be resistant to damage from ice and windstorms.

Leaves of our ideal tree should appear as soon as the danger of frost has passed and, thereafter, maintain a healthy green color. They should remain on the tree until late in autumn, then drop very quickly. Leaves should be small and not need collecting. Our ideal tree should have attractive flowers that are not messy, showy fruit that presents no maintenance problems, good autumn color, and interesting winter structure. It also should have the desired size, shape and texture to fill our design needs. Such a plant should re-establish itself quickly upon transplanting. Its roots should not lift sidewalks or clog utility pipes, and the plant should not be adversely affected by extended illumination. Above all, it should be resistant to insects and diseases and have a long life span.

How is a tree selected for a growing site? First, the user — landscape architect, street tree commissioner or homeowner — should evaluate the site. What are the major environmental constraints that will influence the optimum growth of the tree? Are they shade, limited soil volume, severe cold or perhaps major applications of winter deicing salts? Difficult conditions imposed upon a tree bordering a street in Boston, Massachusetts are usually more complex and intense than those the same tree would face on a street in rural New England. In effect, it should be easier to grow a wider array of plants along rural streets than along city streets; however, few sites are without major limitations.

Next, what are the physical limitations or design needs? An example might be utility wires running above the planting site. For this situation,



*Trees planted within paved areas suffer from limited volumes of infertile, compacted, and droughty soil. They usually are too close to the curb and are subject to injuries from cars being parked.*





*This honeylocust, which is in need of pruning from dieback, attests to the inadequate tree care provided by many municipalities.*

one may want to select a tree that has an ultimate size less than the height of the electric lines to eliminate the expensive periodic pruning needed to keep the tree growth from interfering with the wires. Also, trees in the public domain are more often butchered than skillfully pruned when their growth conflicts with the public utilities. If there is adequate money, equipment and trained personnel to provide high-level maintenance, one might select a large tree and utilize corrective pruning to enable the tree to grow through and above the height of the wires.

Other physical considerations are tree branching that is high enough to allow unobstructed vision or vehicular traffic, tree size that will fill but not overwhelm the scale and proportion of the landscape space, and size and growth form to fulfill a specific design requirement.

Selecting a tree for flowers, fruit or autumn color should have low priority and not even be considered until cultural and physical restrictions have been met. If one selects a beautiful flowering tree that languishes because of site difficulties, it will not be satisfactory as an ornamental or as a street tree.

A word needs to be said about maintenance, for most municipalities select trees on the basis of minimum upkeep. Generally, municipal budgets allow money only for tree installation and little is appropriated for routine care such as corrective pruning, watering during drought, fertilization, or spraying for plant pests. Most urban street trees receive little consideration until a broken limb damages an automobile or severs utility wires, or until a tree dies and needs to be removed. Consequently, the trees installed by municipalities need to be thoroughly tested and evaluated for performance under different environmental conditions. Homeowners have an advantage in that they often can afford to provide the extra maintenance a more ornamental tree might demand.

The following information is intended to provide readers with an accurate assessment of the plants described. By stressing both a plant's assets and limitations we hope to provide data that, when coupled with details about planting sites, will allow one to select the plant that will be best for an individual location. Since no tree will be perfect, it is important to seek the species, variety, or cultivar offering the greatest adaptability and conformance to landscape architectural needs, while posing the fewest maintenance problems.

To assist users in finding plants most appropriate for their sites, quick-reference lists have been provided beginning on page 223. Trees are arranged alphabetically according to cultural adaptability and major landscape attributes such as flower, fruit or autumn color.

The authors invite comments from interested readers who may have additional information relative to a particular plant's performance under street or urban conditions. This information will be collated and added to our reference file on street trees.





*Trees play an important aesthetic role in the planting of this well-designed parking lot.*

CLARIFICATION OF CONTENTS

*Nomenclature:* In general, plant names used in this publication conform to *Hortus Third*, L. H. Bailey Hortorium, Macmillan Publishing Co., Inc., New York, 1976.

*Hardiness Zones:* The zones of hardiness listed here are based on the Arnold Arboretum Zone Map which attempts to define the cold tolerance of north temperate woody plants. While we indicate northern limits, most plants will grow over a broad southern range.

Average Annual Minimum Temperature

Zone 1	–50°F or lower
Zone 2	–50° to –35°F
Zone 3	–35° to –20°F
Zone 4	–20° to –10°F
Zone 5	–10° to –5°F
Zone 6	–5° to 5°F
Zone 7	5° to 10°F
Zone 8	10° to 20°F
Zone 9	20° to 30°F
Zone 10	30° to 40°F

*Plant Size:* An attempt has been made to list average landscape sizes. Many authors have listed size as it applies to native or wild plants. These heights do not accurately reflect the size that may occur under landscape conditions.



The harsh effect of asphalt and concrete buildings is softened by the trees that frame this Boston street.



*Basal suckering is a problem on several tree species, as this linden illustrates.*

## ACKNOWLEDGEMENTS

Many people have assisted in the preparation of this manuscript and the authors appreciate their comments, suggestions and creative criticism. Major contributors of information, time, or interest include William Flemer III, Edward S. Gray, Nancy A. LeMay, Jeanne E. Sattely, Stephen A. Spongberg, Richard E. Weaver, Jr., and Carroll E. Wood, Jr.

Special thanks goes to Jeanne S. Wadleigh, Editor of *Arnoldia*, for her persistence in the task and her patience with the authors. In addition, we would like to acknowledge the value of numerous articles, books and letters containing comments, observations and personal experiences. This vast reservoir of information enabled these authors to draw upon and, we hope, expand what is known about street trees.



*Ailanthus altissima* is among the most stress-tolerant trees. The broken branch on this specimen should be pruned flush with the trunk to effect good wound healing.

### THE BEST STREET TREES

Considering all factors affecting street trees, it takes a strong, adaptable plant to endure today's environmental stresses and survive in reasonably good condition. The following trees have proven durable and functional in appearance, structural strength, pest resistance, adaptability to inhospitable soils, and resistance to storm and mechanical damage. They also require minimal pruning to keep them visually and structurally sound. Barring unforeseen circumstances, they can be expected to live thirty to forty years or more. Most important, they are commercially available in landscape size and generally at reasonable prices.

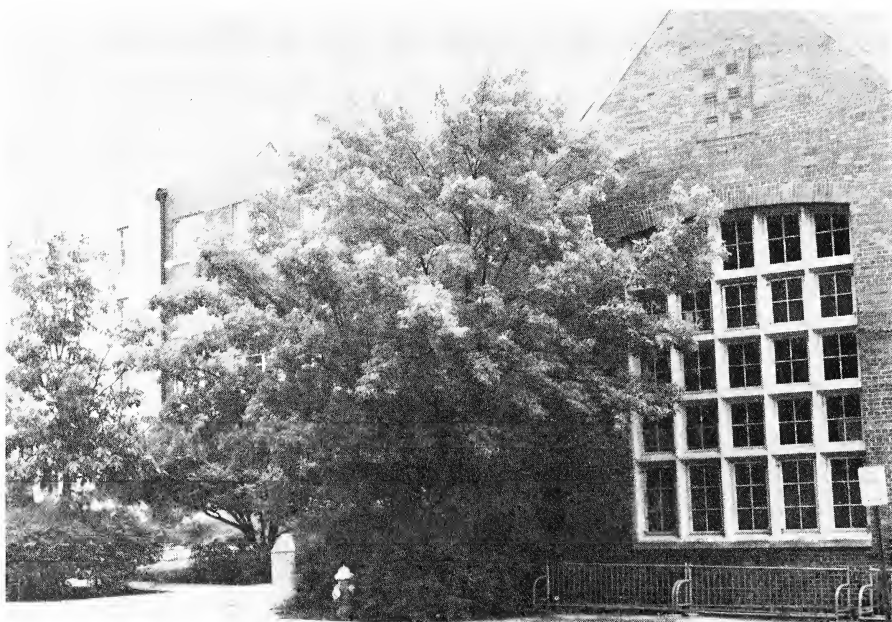
Although these trees represent our choice of the "best," they are not infallible. A plant that performs admirably in one area of the country may not duplicate that effort in another region. Honeylocust has suffered in recent years in the Midwest from canker, webworm, gall, and mites, while in New England these problems do not appear prevalent. The selection of trees for city planting should, therefore, be based on a thorough knowledge of all factors which contribute to their successful establishment.



*Effective use of Pyrus calleryana 'Bradford' for screening a parking lot.*

*Acer buergeranum*

Trident Maple



HEIGHT: 20-35 feet  
SPREAD: 15-25 feet  
HABIT: oval-rounded to rounded

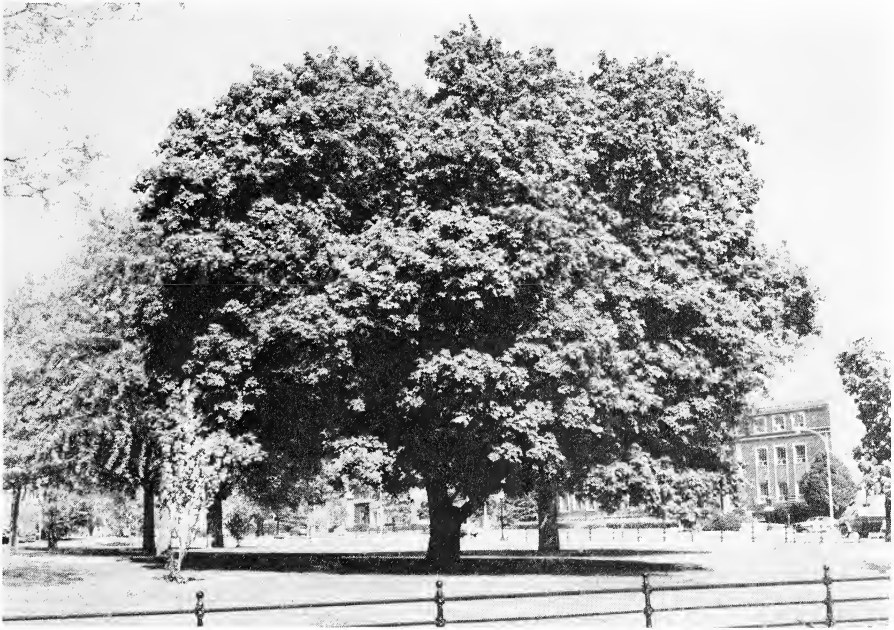
ZONE: 5, perhaps best in 6  
ENVIRONMENT: full sun to light shade; well-drained soil; withstands drought and heat



A small tree with lustrous, dark green foliage that turns yellow and red in fall, *Acer buergeranum* exhibits good pest and drought tolerance. The bark is a handsome orange-brown and develops a scaly, platy characteristic. Trident maple would make a good street tree but has not been tried to any degree. Since it is variable from seed, superior selections might be made; however, lack of availability may limit its use.

### *Acer campestre*

### Hedge Maple



**HEIGHT:** 25-30 feet (50 feet)  
**SPREAD:** 25-35 feet  
**HABIT:** rounded, dense, usually  
 low-branched

**ZONE:** 4  
**ENVIRONMENT:** full sun to light  
 shade; well-drained soil; pH adapt-  
 able; tolerates drought and heat



*Acer campestre* is a good tree for dry, high pH soils, and it is beginning to appear in street and urban plantings. Its dark green, pest resistant foliage may turn a good yellow in fall and remains on the tree later than on any other maple with the exception of *A. platanoides*. The tree tends to be low-branched, and proper pruning is necessary to form a single-stemmed plant.

West Coast nurserymen will be introducing selections for better form. Evaluations at the Ohio Shade Tree Plots have indicated that *A. campestre* is more tolerant of environmental pollution and differing soil conditions than had been previously recognized.

## *Acer platanoides*

## Norway Maple



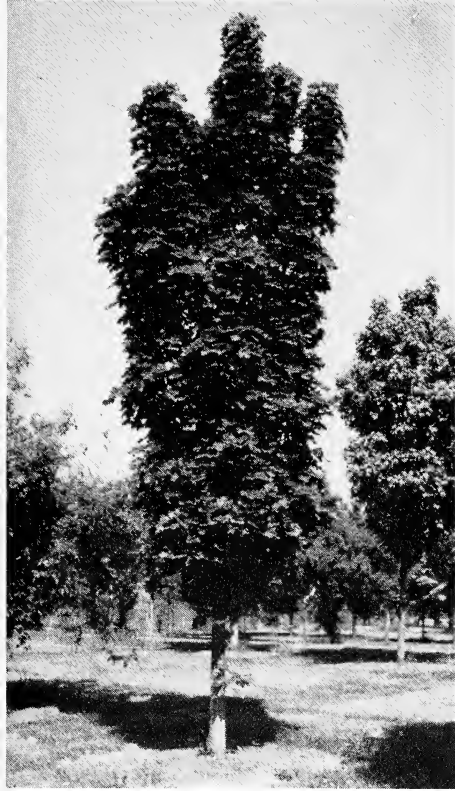
HEIGHT: 40-70 feet  
SPREAD: 40-60 feet  
HABIT: rounded, dense

ZONE: 4  
ENVIRONMENT: full sun to light shade; well-drained acid or alkaline soil; more tolerant of dry soils than many maples

*Acer platanoides* has long been one of the most common shade and street trees, but it is gradually losing favor because of its disease susceptibility. Its dark green foliage turns golden-yellow in fall when it and *A. campestre* are the last maples to drop their leaves. The showy yellow-green flowers appear before the leaves in May. Norway maple is extremely dense-headed and shallow-rooted, making grass culture under its canopy virtually impossible; it is, however, very tolerant of pruning. *Verticillium* wilt causes sporadic dieback of branches and will kill entire trees. This disease is becoming more severe throughout the East

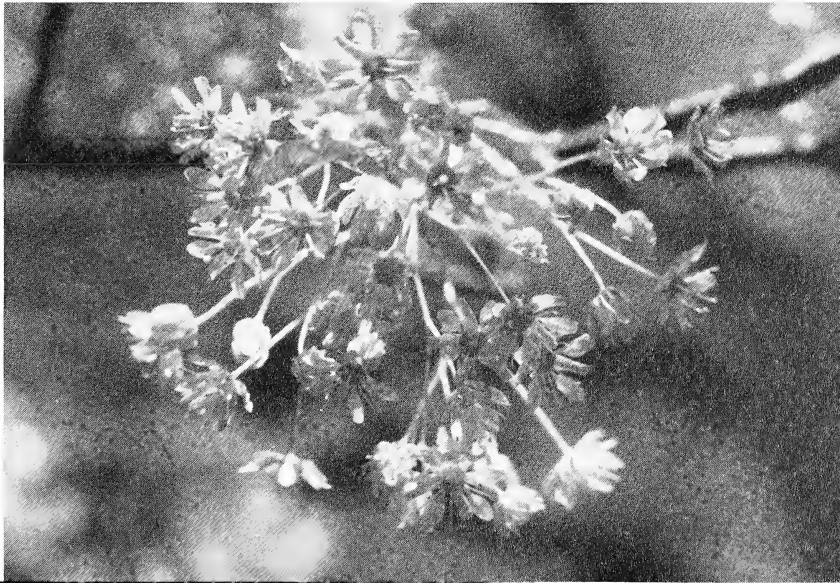


and Midwest. Many cultivars have been selected and the following may prove superior to the species for street use: 'Cleveland' — upright oval habit; 'Columnare' — narrowly upright; 'Emerald Queen' — ascending branches, upright-oval outline; 'Schwedleri' — purplish-red spring foliage changing to green in early summer; 'Summer Shade' — heat-resistant, upright-oval in shape.



*Left: Acer platanoides 'Erectum'*

*Below: Flowers of A. platanoides*



*Acer pseudoplatanus*

**Sycamore Maple**



**HEIGHT:** 40-60 feet

**SPREAD:** 30-50 feet

**HABIT:** upright-spreading branches  
form an oval to rounded outline that  
is not consistently uniform

**ZONE:** 5

**ENVIRONMENT:** full sun to light  
shade; well-drained, dry to moist  
soil; tolerates saline conditions; pH  
adaptable



Sycamore maple is not a particularly valuable ornamental but is superlative where saline conditions exist. It withstands salt spray and because of this attribute has been widely planted in Holland and on Cape Cod. Summer foliage is a deep green, and the bark is an unusual grayish- to orange-brown, flaking off in small rectangular scales. There are several cultivars, including 'Erectum', an upright form, and 'Purpureum' in which the underside of the leaf is purple-colored. Ornamental interest of this tree is not superior to red or sugar maple, and its use should be reserved for areas where deicing or ocean salts present a cultural problem.

### *Acer rubrum*

### Red Maple



HEIGHT: 50-80 feet

SPREAD: 40-60 feet

HABIT: pyramidal in youth developing ascending branches that result in an irregular ovoid or rounded crown

ZONE: 3

ENVIRONMENT: full sun to light shade; wet to dry, acid soils; spring transplanting is recommended



Left: *Acer rubrum* 'Columnare'; right:  
*A. rubrum* bark

The medium green summer foliage of this tree may turn brilliant red to yellow in autumn. Its flowers appear in April before the leaves, and vary from red to yellow; some individual plants are showy in flower as well as in fruit. Silvery-gray bark adds winter interest. Rapid growth and ease of culture make this a superior tree, but in many areas its use is approaching a monoculture. Its limitations include a shallow root system, weak structure, and a tendency to produce numerous unwanted seedlings. Presently there is a major problem of graft incompatibility on many cultivar selections, but this should be solved soon since propagation by cuttings is becoming more common. Many worthwhile cultivars have been chosen for red fall coloration; they include 'Autumn Flame', 'October Glory', 'Red Sunset', and 'Schlesingeri'. Selections for upright habit include 'Armstrong', 'Bowhall', and 'Columnare'. 'Red Sunset' has proved to be the hardiest of those chosen for red fall coloration.

*Aesculus* × *carnea* 'Briotii'**Ruby Red Horsechestnut**

HEIGHT: 30-40 feet  
 SPREAD: 30-40 feet  
 HABIT: rounded, dense, low-branched  
 ZONE: 3  
 ENVIRONMENT: full sun; well-drained, acid to neutral soil



Ruby-red flowers in May and its dense habit make this horsechestnut a fine tree. Its lustrous, dark green foliage is resistant to leaf blotch, which is so troublesome on *Aesculus hippocastanum*, and it consistently outperforms that species in confined growing areas. Widely used in England for avenues and parks, it probably is unsurpassed for street use by any other tree in its genus, but it is a very slow grower.

*Ailanthus altissima*

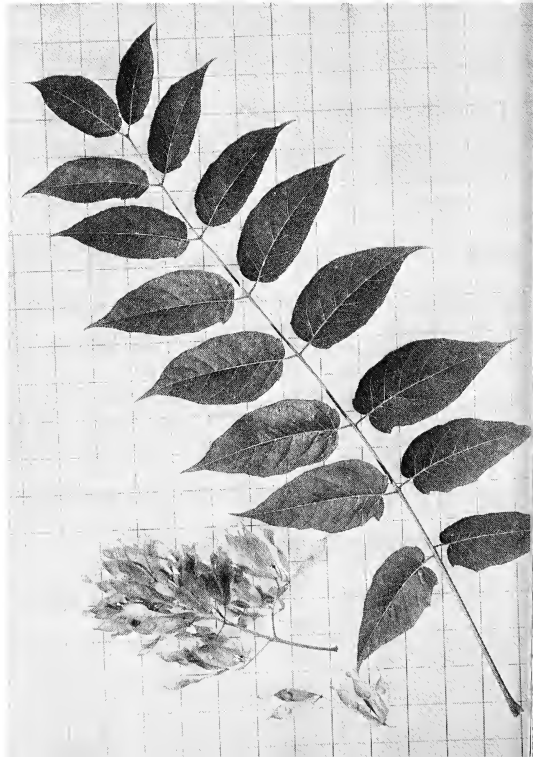
Tree of Heaven



HEIGHT: 40-60 feet  
SPREAD: 25-40 feet  
HABIT: upright-spreading, open;  
coarse, with thick clubby branchlets

ZONE: 4

ENVIRONMENT: full sun to light  
shade; well-drained, dry soil; pollu-  
tion tolerant; pH adaptable; exhibits  
aerial salt tolerance





Tree of heaven is one of the toughest trees for urban areas, though often belittled because of its weedy tendencies. The dark green summer foliage has a tropical appearance. The yellow-green flowers open in June or July and staminate (male) flowers have a mildly unpleasant odor. Pistillate (female) plants produce fruits that occur in large clusters varying from green to bright red and can be very ornamental. Selection of good colored fruit forms needs to be made. The plant suckers and seeds to form large colonies. Because of weak structure, it is subject to damage from ice and wind storms. It is ideal as a quick-colonizing species for difficult sites, and tolerates heat and atmospheric pollutants better than most trees. It would make a good container plant on a temporary basis.

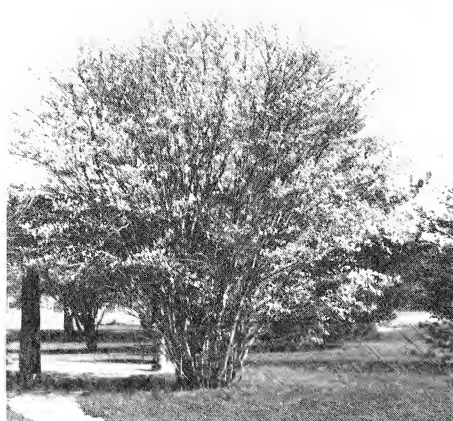
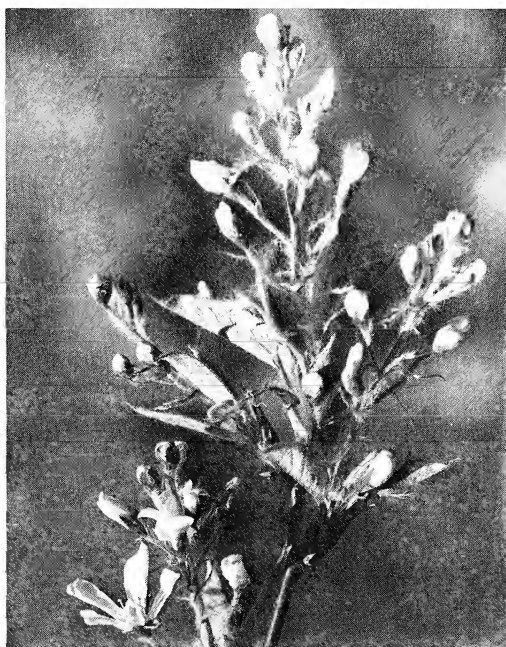
### *Amelanchier arborea*

### Downy Serviceberry, Shadbush



**HEIGHT:** 15-25 feet (40 feet)  
**SPREAD:** 15-25 feet  
**HABIT:** large shrub or small tree,  
 usually forming a rounded crown;  
 quite variable in habit

**ZONE:** 4  
**ENVIRONMENT:** full sun to light  
 shade; well-drained, moist, acid or  
 slightly alkaline soil



Left: *Amelanchier arborea* bark; top right: flowers of *A. arborea*;  
below: *A. canadensis*



This is a fine species, one that has not been used to any degree for street or urban plantings. The medium green summer foliage changes to rich yellow, apricot, and red in fall. Short-lived, white, fleecy flowers develop with the leaves in April. The purplish-black fruits (June) are attractive and edible. Smooth gray bark marked with slight vertical fissures adds winter interest. The species has been successfully utilized in suburban areas where the tree lawns were spacious and pollutants were minimal. It suffers from leaf rust, mildew, fire blight, borers and several other pests that may limit its acclimation to heavily stressed areas. This species can be trained as a single-stemmed tree but most nurseries grow it as a multistemmed shrub. It transplants readily and offers a highly ornamental alternative to *Malus*, *Prunus* and *Crataegus*. *Amelanchier laevis*, Allegheny serviceberry, is similar in size and ornamental characteristics but differs in the color of the expanding leaves (bronze to purple compared to the gray of *A. arborea*), and the less pubescent (hairy) inflorescence. Another species, *A. canadensis*, shadblow serviceberry, is often confused with *A. arborea* in the nursery trades. It is a multistemmed shrub that matures at a height of 12-20 feet. The flowers are smaller and are borne in tighter, smaller racemes.

### *Carpinus betulus*

### European Hornbeam, Ironwood



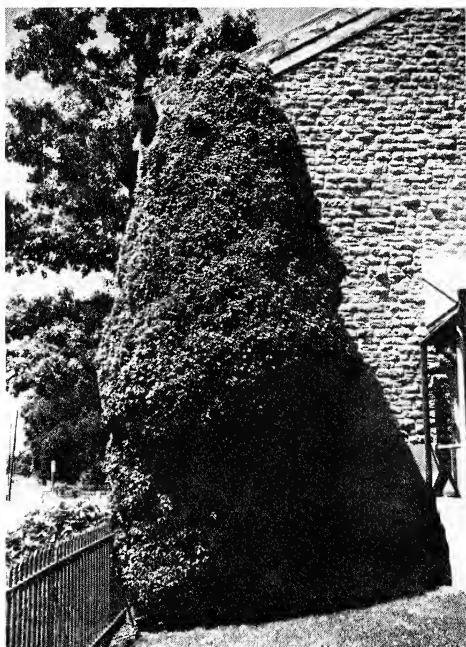
HEIGHT: 40-60 feet

SPREAD: 30-60 feet and wider

HABIT: often pyramidal-oval in youth; at maturity ranging from oval-rounded to broad-spreading; extremely variable in habit

ZONE: 4

ENVIRONMENT: full sun, although a modicum of shade is acceptable; moist, well-drained soil; tolerates acidity and alkalinity as well as drought; shows good pollution tolerance



*Left: Carpinus betulus 'Globosa'; right: C. b. 'Columnaris';*

*below: C. b. 'Fastigiata'*



This species and the cultivars are superlative ornamentals, well-adapted to street and city use. The dark green foliage may turn yellow in fall. The sinewy, fluted, gray bark provides winter interest. The species is extremely variable in habit, which may limit its value for street purposes. It can, however, be used in parks and other open areas. Several cultivars have been successful along streets and in containers. 'Columnaris' is a densely-branched and foliated, spire-like, slow-growing form that usually maintains a central leader. 'Fastigiata' is the most common cultivar in cultivation and with age develops a vase shape, with distinct fan-ribbed branches. It may grow 30-40 (50) feet tall and 20-30 feet wide. It does not develop a central leader and the foliage is more uniformly distributed along the branches than on 'Columnaris' or 'Globosa'. 'Globosa' becomes rounded to globose in outline with no central trunk. All cultivars make good container plants, screens, or groups. *Carpinus betulus* and the cultivars are superior to the North American native, *C. caroliniana*, because of greater pollution tolerance.

### ***Celtis occidentalis***

### **Hackberry**



**HEIGHT:** 40-60 feet  
**SPREAD:** 40-60 feet  
**HABIT:** upright, open, irregular

**ZONE:** 2  
**ENVIRONMENT:** full sun to light shade; wet or dry soils; pH adaptable; wind-stable

Hackberry is a "tough" tree in the sense that it is extremely adaptable. It withstands the windswept, dry conditions of the prairie but also occurs as a flood plain species. Its summer foliage is a light, often sickly green, while limited yellow coloration may occur in fall. The fruits are dark purple, brown or black, and have a date-like taste; robins supposedly relish them. The gray bark develops corky warts or ridges. A witches-broom condition (branches becoming fasciated and appearing broom-like) occurs on many specimens and is unsightly; nipple gall is a problem on leaves. Although a member of the Ulmaceae, *Celtis occidentalis* is immune to Dutch elm disease. A weed tree that is often found in many out-of-the-way areas, it transplants readily and tolerates polluted conditions. Selections need to be made for improved ornamental characteristics. 'Prairie Pride' has lustrous, dark green foliage and freedom from witches-broom. 'Magnifica' is a hybrid clone with very vigorous growth and freedom from witches-broom.

### *Cornus kousa*

### Japanese Dogwood



HEIGHT: 15-20 feet (perhaps 25-30)

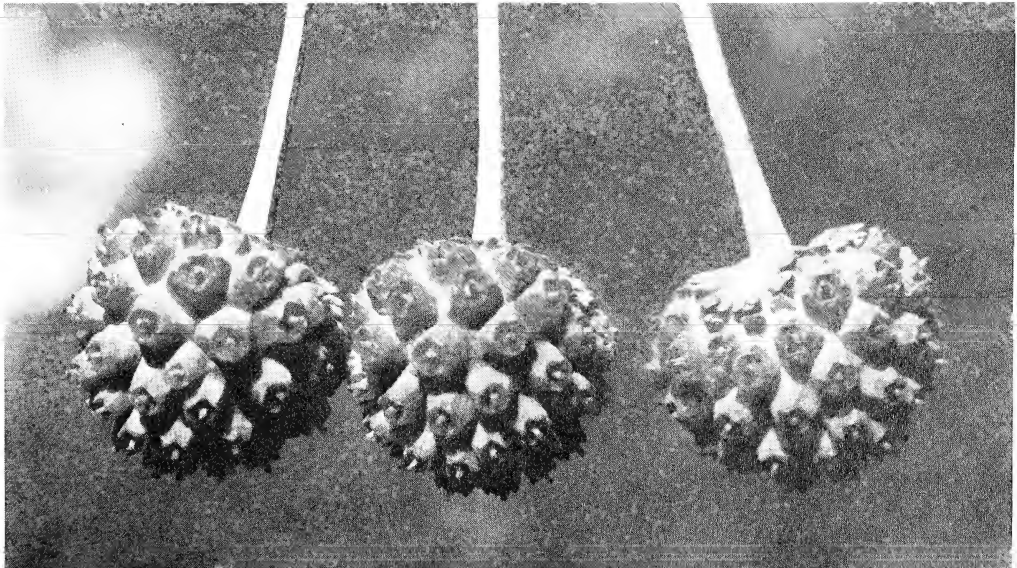
SPREAD: 15-20 feet

HABIT: large shrub or small, low-branched tree; often developing a broad crown with horizontal branches

ZONE: 5

ENVIRONMENT: full sun or partial shade; well-drained, moist, acid soil; more drought, heat and cold tolerant than *C. florida*

Based on the inadequate performance of *Cornus florida* after the winters of 1976-'77 and '77-'78, this species probably is a better choice. It is structurally stronger and more flower-bud-hardy than *C. florida* and, therefore, better adapted to northern areas. The lustrous, dark green foliage of *C. kousa* develops a rich reddish-purple fall color that persists until the leaves fall. In June the flower clusters with their four conspicuous, pointed, white bracts are borne above the leaves. The raspberry-colored and shaped fruits mature in August. Bark on old trunks develops a patchy, quilt-like mosaic. Leaf scorch may limit use in extremely dry situations and, therefore, Japanese dogwood should not be used in areas with limited soil volumes. Little is known of its tolerance to polluted conditions. It requires pruning in the nursery to produce a single-stemmed tree. The variety *chinensis* 'Milky Way' is more floriferous than the species; bracts on 'Summer Stars' hold up to six weeks after the normal flowering period, the fruits are abundant, and the foliage turns maroon in fall.





*Cornus mas*

Cornelian-cherry



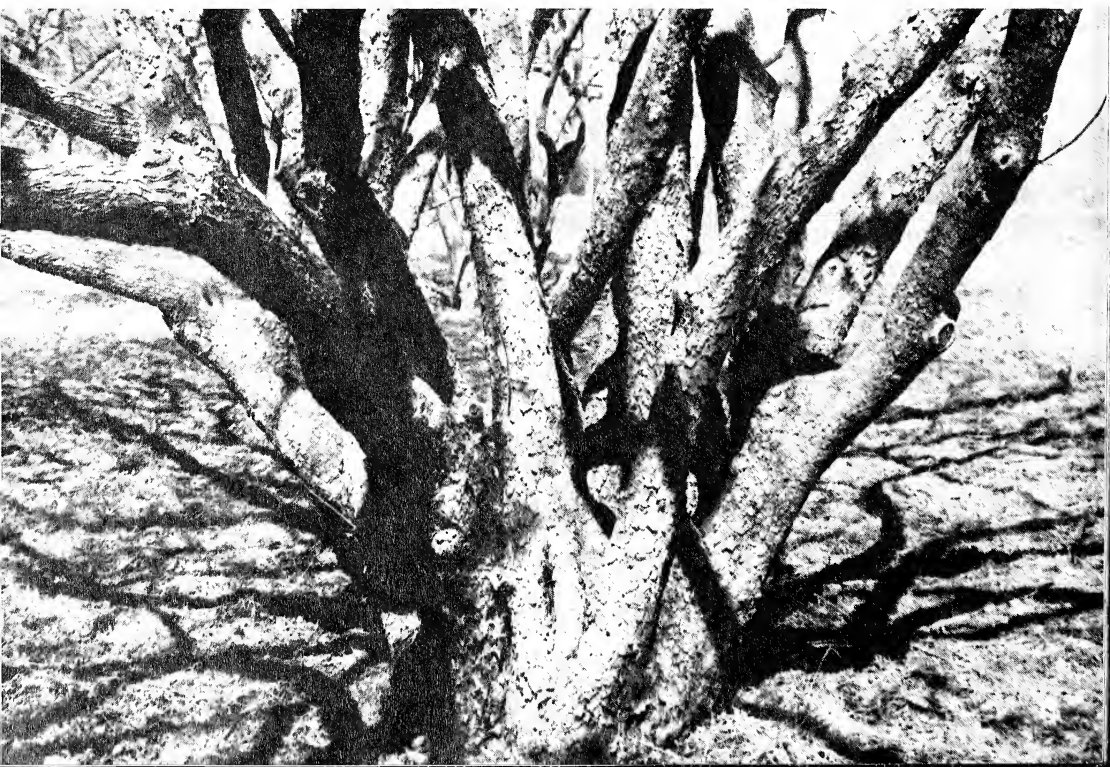
HEIGHT: 15-20 feet

SPREAD: 15-20 feet

HABIT: large shrub or small tree of  
rounded outline

ZONE: 4

ENVIRONMENT: full sun to light  
shade; well-drained, moist or dry soil;  
pH adaptable



Cornelian-cherry is one of the most adaptable dogwood species and one that performs well in dry, high pH soils. Its lustrous, dark green, pest free summer foliage holds late and does not develop the reddish-purple common to many dogwood species. Small, abundant yellow flowers appear before the leaves in March or April and may last three weeks. The cherry-like, red fruits mature in July-August, and are borne under the foliage. They are relished by birds and can be used in preserves. The bark may develop a slight scaly character, presenting a mottle of gray, brown, and orangish-brown. *Cornus mas* can be used in containers and, if pruned, will make a very suitable small street tree. It probably is the most pollution-tolerant and soil-adaptable dogwood for city conditions. 'Flava' has large yellow fruits that are sweeter than those of the red type.

### *Cornus officinalis*

### Japanese Dogwood



HEIGHT: 15-20 feet

SPREAD: 15-20 feet

HABIT: large shrub or small tree of rounded outline

ZONE: 4

ENVIRONMENT: full sun to light shade; well-drained, moist or dry soil; pH adaptable

Because of its similarity to *Cornus mas*, this is an overlooked species although it flowers a week earlier and its fruits ripen about a month later. Japanese dogwood has axillary tufts of brownish hairs on the underside of the leaf, and its bark exfoliates more than does the bark of *C. mas*. It is definitely a worthwhile alternative.



***Crataegus crus-galli***

**Cockspur Hawthorn**



**HEIGHT:** 20-30 feet

**SPREAD:** 20-35 feet

**HABIT:** broadly rounded, low-branched tree with wide-spreading horizontal branches and numerous 1- to 3-inch-long thorns

**ZONE:** 4

**ENVIRONMENT:** full sun; adaptable to varied soils; may contract chlorosis in high pH soils





From the Atlantic seaboard to the far reaches of the Midwest, this species tends to outperform most hawthorns. The lustrous, dark green foliage turns wine-red in fall and the white, malodorous flowers (June) are followed by deep red, semipersistent fruits in September and October. The principal objections to street tree use are its low-branched, wide-spreading crown and the 1- to 3-inch-long lethal thorns. The variety *inermis* possesses the fine ornamental traits of the species but has no thorns. Cedar hawthorn rusts can affect leaves, stems, and fruits, especially in rainy seasons. Leaf miner also can be troublesome. *Crataegus crus-galli* is a good choice for barriers and screens, since it forms an impenetrable thicket. Tolerance of dry, infertile, compacted soils, the soot and grime of cities, and a long life span place it at the forefront of the hawthorns for the urban landscape.

### *Crataegus phaenopyrum*

### Washington Hawthorn



HEIGHT: 20-30 feet

SPREAD: 15-25 feet

HABIT: broad-oval to rounded,  
densely branched and armed with  
prominent thorns

ZONE: 4

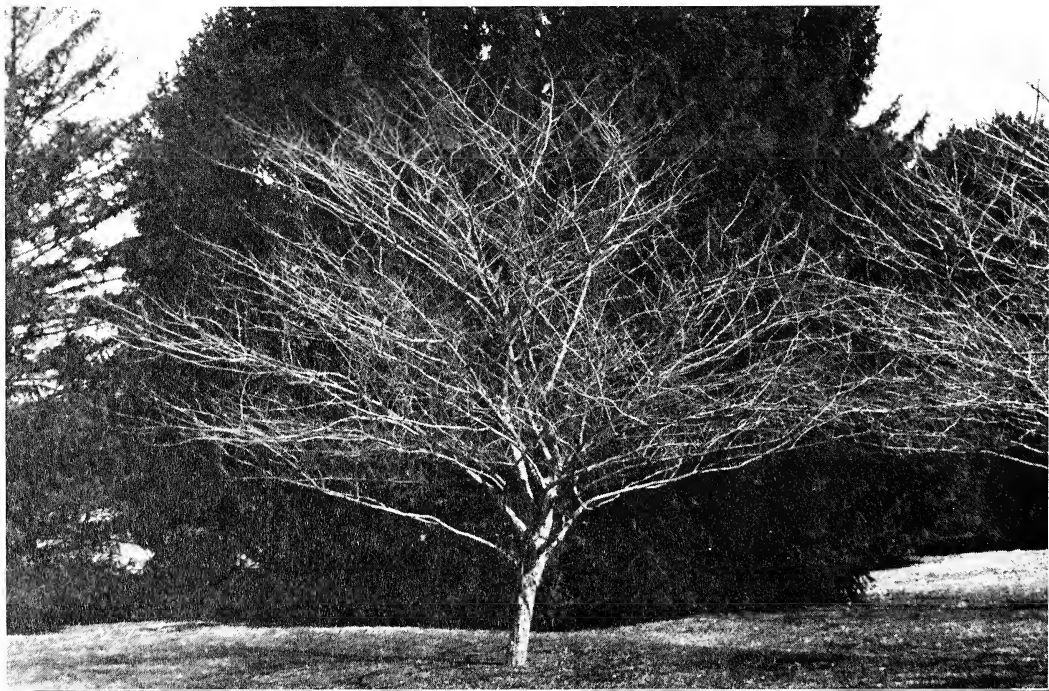
ENVIRONMENT: full sun; heavy clay  
to sandy, well-drained soils; tolerant  
of urban pollution; pH adaptable



This species proves to be a superior ornamental wherever it is grown and may be number one among the hawthorns for its landscape attributes and cultural adaptability. The best known hawthorn, it is the one most often specified by landscape designers. In the nursery trade, it is often grown in two forms: a multistemmed large shrub, and a single-stemmed small tree. The lustrous green foliage frequently becomes reddish-purple in fall. The last hawthorn to bloom, it bears fragrant, white flowers in June; these are followed by small, bright red fruits in September-October which may persist through winter. The leaves hold extremely late (often into November) and may mask the fruit display. Washington hawthorn is subject to cedar hawthorn rusts which may affect leaves, stems and fruits. Woolly aphids and lace-bug can be troublesome. *Crataegus phaenopyrum* has been used extensively for streets, parks, and above-ground containers. It can be pruned into an effective hedge or barrier. Thorns on this and other hawthorns hamper transplanting and maintenance operations. The selection of a thornless form would be beneficial.

***Crataegus viridis* 'Winter King'**

**Winter King Hawthorn**

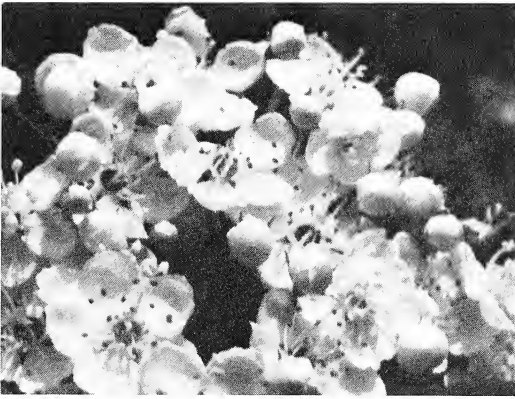


**HEIGHT:** 20-30 feet  
**SPREAD:** 20-30 feet  
**HABIT:** vase-shaped branches form  
 a rounded crown; very uniform  
 branching habit

**ZONE:** 4

**ENVIRONMENT:** full sun; heavy clay  
 to well-drained soil; pH adaptable

Probably the best new hawthorn for urban plantings, this cultivar has abundant clusters of white flowers in May, followed by  $\frac{3}{8}$ -inch-diameter red fruits that persist through winter. The lustrous, medium green foliage does not color well in fall. The young stems are an attractive bloomy (waxy), grayish-green, and older trunks develop an exfoliating bark. This plant appears resistant to the rust disease, but in extended wet periods will contract the disease on foliage, fruits and stems. It makes a splendid street, lawn, park or golf course tree and is beautiful in mass plantings. It is produced by budding and, therefore, trees are quite uniform, which is not true for *Crataegus crus-galli* and *C. phaenopyrum*, which are seed-grown.



***Fraxinus americana***

**White Ash**



**HEIGHT:** 50-65 feet

**SPREAD:** 50-65 feet

**HABIT:** in youth, weakly pyramidal  
to upright-oval; becomes round-topped  
and open with age

**ZONE:** 3

**ENVIRONMENT:** full sun; moist to  
dry soils; pH adaptable



White ash is one of the most adaptable native, eastern North American trees, yet often is overlooked for use in landscape plantings. The compound, dark green summer foliage develops rich maroon and yellow colors in fall, the outer leaves becoming maroon with a gradation to yellow toward the trunk. Some trees, however, become a uniform reddish-purple. The bark is gray-black, deeply ridged and furrowed with a diamond-like pattern. Assets include rapid growth and ease of transplanting, while limitations include borers, canker, scale, and, in recent years, a type of dieback termed "ash-decline." 'Autumn Purple', 'Rose Hill', and 'Autumn Applause' are seedless forms (staminate) that have deep reddish-purple fall color and are superior to the species for consistency of coloration. The species is dioecious (sexes separate) and selection of male types is desirable to avoid the prolific seeds.

### *Fraxinus pennsylvanica*

### Green Ash



**HEIGHT:** 50-60 feet

**SPREAD:** 30-40 feet

**HABIT:** softly pyramidal in youth, developing an upright-spreading habit at maturity, usually with 3 to 5 large, coarse main branches

**ZONE:** 3

**ENVIRONMENT:** full sun; wet or dry soils; pH adaptable; heat and air pollution-tolerant

This species has been overused as a street tree due to its exceptional tolerance of alkaline soils and city conditions. Pistillate trees produce abundant fruits at a young age, and the seedlings may present weed problems. The foliage varies from dull to lustrous green, and fall color may be a good yellow. *Fraxinus pennsylvanica* is susceptible to storm damage, insects (borers), and canker. 'Marshall's Seedless' is a staminate clone with lustrous, dark green foliage and good yellow fall color; it also appears to be more vigorous and has fewer insect problems than the species. 'Summit' is a staminate selection of pyramidal outline which forms a more uniform crown compared to 'Marshall's Seedless' and also develops excellent yellow fall colors. Green ash is a popular tree in the plains states, (Kansas, Nebraska, Dakotas) for it tolerates drought, heat, cold, high pH soils, and wind. One of the most city-tolerant trees, it should be considered where growing conditions are difficult.

## *Ginkgo biloba*

## Ginkgo



HEIGHT: 50-70 feet  
 SPREAD: 30-70 feet  
 HABIT: pyramidal to irregular to  
 broad-rounded at maturity

ZONE: 4  
 ENVIRONMENT: full sun; moist or  
 dry soils; tolerant of air pollution;  
 pH adaptable





*Left: Fruits of Ginkgo biloba; above G. b. 'Fastigiata'*

This is an excellent city tree, but seed-grown plants suffer from lack of uniformity and it is impossible to determine if they are staminate (male) or ovulate (female) until they bear "fruit" (technically, naked seeds). Seed-bearing trees are undesirable because the "fruits" upon decomposition have the odor of rancid butter and also present a hazard to pedestrians because of the slippery, fleshy outer layer of the seed coat. Growth is slow. Young trees are rather gaunt and considerable time (fifteen to twenty-five years) is required before a full, dense crown is developed. The bright green foliage usually turns butter-yellow in fall. Staminate cultivars include 'Autumn Gold', 'Lakeview', 'Mayfield', and 'Santa Cruz'. 'Sentry' is a fastigate staminate clone that is effective in restricted growing areas. Ginkgo is remarkably insect and disease resistant and this fact, coupled with pollution tolerances, makes it a valuable tree for urban situations.

*Gleditsia triacanthos* var. *inermis*

## Thornless Honeylocust



HEIGHT: 30-70 feet

SPREAD: 40-60 feet

HABIT: spreading crown of rounded  
to broad-rounded outline; open, airy  
texture

ZONE: 4

ENVIRONMENT: full sun, tolerates  
drought and saline conditions; pH  
adaptable

At the present time, this plant is the most popular tree for streets, parks, malls, residences and containers; in part, because the light, airy composition of its canopy allows grass to be maintained up to the base of the trunk. Tolerant of extremely moist to dry soils, as well as saline conditions, *Gleditsia triacanthos* var. *inermis* is probably the best landscape tree where aerial salts are present. Its bright to medium green foliage may turn golden-yellow in fall. On fruiting specimens, the long, flat, brownish seed pods tend to be messy. Insects and diseases have become increasingly prevalent as this tree assumes monoculture status. Although a good tree, its use should be tempered with the knowledge that mimosa webworm, pod gall, locust plant bug, mites, and canker may prove troublesome. Cold winters in recent years, however, have decreased mimosa webworm populations. Many cultivars are available, and it is virtually impossible for even experienced nurserymen to distinguish among them. One exception is 'Sunburst', which has golden-yellow color on new leaves. Of the green forms, 'Skyline' and 'Shademaster' are among the best, both being essentially fruitless. Thornless honeylocust is an easy tree to transplant in large sizes and is well adapted to container culture. The cold winters of the last seasons have resulted in much dieback, and individual cultivars need to be evaluated for cold hardiness.



*Gymnocladus dioica***Kentucky Coffeetree**

**HEIGHT:** 50-70 feet  
**SPREAD:** 30-50 feet  
**HABIT:** vertically ascending  
 branches form a narrow, obovate  
 crown; bare-limbed and picturesque  
 looking in winter

**ZONE:** 4  
**ENVIRONMENT:** full sun; tolerates  
 drought and city conditions; pH  
 adaptable

Selected specimens of this native species rival any plant offered by the nursery trades. The Kentucky coffeetree has been overlooked for landscape use. The bluish-green, pinnately compound foliage may turn a good yellow in fall, and the grayish-brown to dark brown bark develops tortuous and recurved plates and is quite handsome in the winter landscape. Pistillate trees, however, bear abundant quantities of large, leathery seed pods that drop sporadically through the seasons and may constitute a litter problem. The species could be considered where a light foliage canopy is desired, and appears to be more air pollution tolerant and soil adaptable than is generally recognized. It is a fine tree for parks and other large areas. Its street tree use might be limited by size, coarseness, and variability of seed-grown material. Selected forms can be propagated from root cuttings.



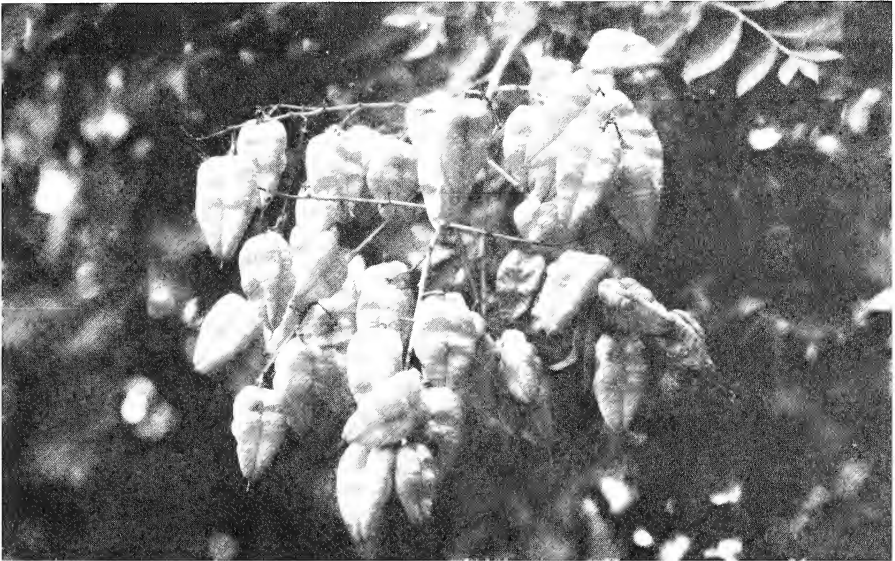
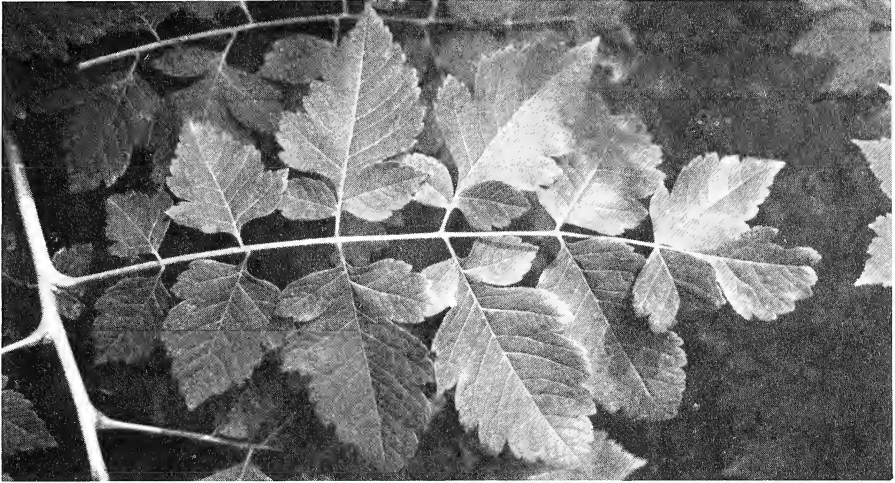
***Koelreuteria paniculata***

**Goldenraintree**



**HEIGHT:** 30-40 feet  
**SPREAD:** 30-40 feet  
**HABIT:** tree of regular, rounded outline

**ZONE:** 5  
**ENVIRONMENT:** full sun; withstands drought, heat, wind, alkalinity; spring transplanting is recommended



Goldenrain tree is a superlative plant for lawns, parks, campuses, and possibly streets, where it has not been used to any degree. Its emerging foliage is bronze or purple-tinged; at maturity it is a rich green. The yellow flowers (July-August) are borne in wide, 12- to 15-inch-long panicles; the papery capsules that develop soon after go through a green to yellow to brown color transition. *Koelreuteria* is extremely tolerant of dry, alkaline soils and seems to withstand atmospheric heat and air pollutants. Cold limits its use in the North, for when temperatures drop below  $-20^{\circ}$  to  $-25^{\circ}$  F, injury may ensue. Although this tree has previously been described as weak-wooded, the authors have not observed breakage. 'Fastigiata' is an upright form that may be 25 feet high and only 4-6 feet wide and does not flower well. 'September' extends the flowering season into late August and September but is not as hardy as the species.

*Liquidambar styraciflua*

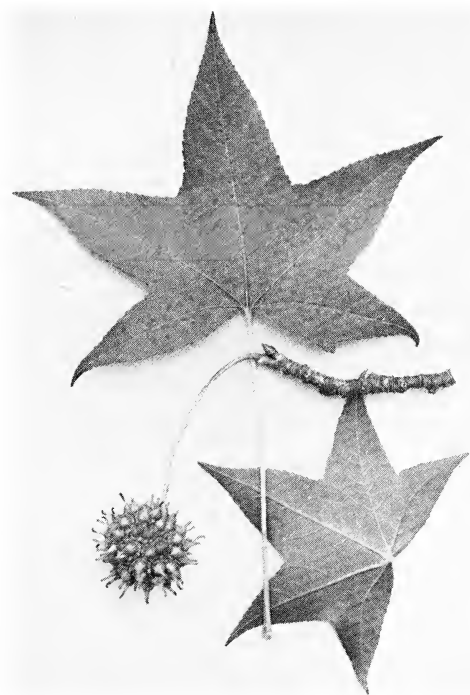
## American Sweetgum



HEIGHT: 60-75 feet  
 SPREAD: 60-75 feet  
 HABIT: pyramidal in youth, rounded  
         at maturity

ZONE: 5  
 ENVIRONMENT: full sun; moist to  
                   wet, acid soil; spring transplanting is  
                   recommended

Widely used throughout the Midwest, West and South for street tree plantings, sweetgum's use in the North is limited by hardiness. Trees should be spring-planted, since many young, fall-transplanted specimens were killed during the winters of 1976-'77 and '77-'78. The lustrous, dark green foliage changes to yellow, red, and purple in fall. Spherical, 1- to 1½-inch-diameter fruits create litter through fall and winter. Chlorosis will develop in high pH soils. The tree is extremely tolerant of wet soils and throughout the South it is almost weedlike on wet, swampy sites. Sweetgum needs considerable root space and is not well-suited to restricted growing areas. 'Moraine' has lustrous, dark green foliage followed by red-purple fall tones and was not injured at Wooster, Ohio, after the severe winters of 1976-'77 and '77-'78. The leaves on 'Variegata' develop yellow mottled patterns with no two leaves exactly similar. Sweetgum is a fast growing tree and will make a fine lawn, park, or street tree if proper cultural conditions are provided. Lack of cold hardiness is a significant problem and temperatures in the range of -10° to -15°F will induce some stem damage. Seeds should be collected from the northernmost reaches of the native range to insure a measure of cold hardiness.



***Magnolia kobus* var. *loebneri* 'Merrill'**

**Merrill Magnolia**

**HEIGHT:** 20-35 feet

**SPREAD:** 20-30 feet

**HABIT:** tight, upright, pyramidal outline

**ZONE:** 4

**ENVIRONMENT:** full sun; tolerates infertile but well-drained soils; pH adaptable; transplant in spring







In April, the Merrill magnolia is covered with fragrant, white, multipetaled flowers. Autumn foliage is yellowish-brown and not outstanding. It is tolerant of drought and difficult urban growing conditions. Plants flower well when young and the floral display is a welcome relief after a long winter season. This cultivar is similar to *Magnolia kobus* var. *stellata*, star magnolia, in floral characteristics but has larger flowers with fewer petals and is faster and taller growing. With proper pruning, it could be trained into a tree form which would make it suitable for streets. Adequate moisture throughout the early years of establishment is necessary since magnolias tend to be fleshy-rooted and do not have an abundance of absorbing roots or root hairs.

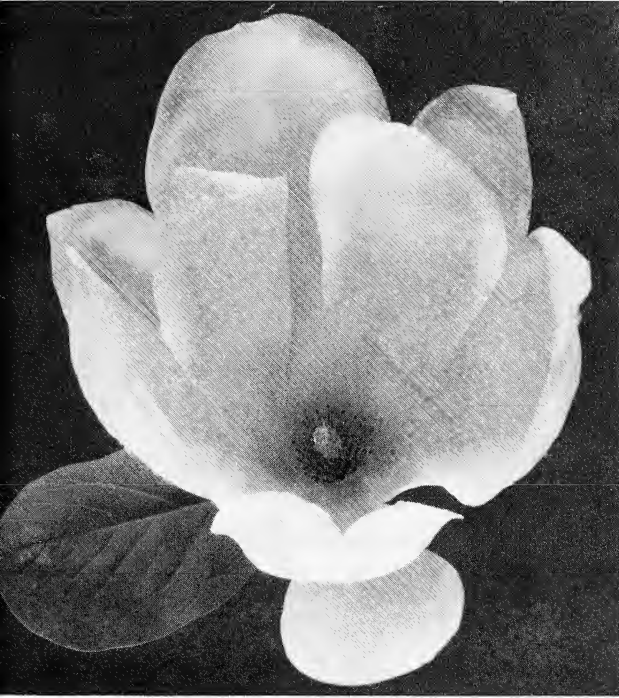
### *Magnolia* × *soulangiana*

### Saucer Magnolia



HEIGHT: 20-25 feet  
 SPREAD: 20-25 feet  
 HABIT: rounded and spreading;  
 often low-branched and multiple-  
 stemmed; requires considerable prun-  
 ing for maintenance of a single leader

ZONE: 5  
 ENVIRONMENT: full sun; adapts to  
 difficult growing conditions and air  
 pollution; requires good drainage;  
 prefers acid soil



Left: *Magnolia* × *soulangiana* 'Brozzonii'; right: bark of *M.* × *soulangiana*

This plant is a hybrid between *Magnolia heptapeta* (*M. denudata*), from which the large, cup-shaped flowers are derived, and *M. quinquepetala* (*M. liliflora*), to which the rose to purple flower color is attributable. The bark is an attractive, smooth gray. Widespread urban use has shown this to be an adaptable, structurally sound, long-lived and pest free tree. Disadvantages include the flower color, which tends toward a muddy purple in some cultivars, the wide-spreading habit, and the litter problem from fallen flowers. *M.* × *soulangiana* is probably best used in planting spaces where it can be allowed to branch with minimal pruning. When required, pruning should be done immediately after flowering. Floral variation is considerable among cultivars, and there is much nomenclatural confusion in the trade. For this reason, trees should be selected when in flower and then transplanted in spring. Superior cultivars include 'Alba Superba', an early, fragrant white; 'Alexandrina', with white on the inside of the petals and lavender-pink outside; 'Brozzonii', a late flowerer with tepals of white with a pink flush; 'Lennei', large, relatively tight-clustered, reddish-purple flowers and a more spreading, sprawling, low-growing habit; 'Lombardy Rose', with long, narrow pink flowers in late May; and 'Verbanica', featuring lavender-pink flowers, again in late May.



**Malus****Flowering Crabapple**

Any treatment of crabapples is soon outdated, for new ones are introduced annually and adequate evaluation is not possible until ten to twenty years later. Crabapples usually are small trees with showy white, pink, rose, or purplish-red flowers. Their fruits vary in color from green to yellow to red, and in size from ¼-inch to 2 inches in diameter. Crabapples seldom color well in fall although *Malus florentina*, *M. hupehensis* and *M. tschonoskii* can be effective. The trees are easy to transplant and are adaptable to light loamy soils as well as clayey situations. They prefer a slightly acid soil but seem to be able to grow over a wide pH range (pH 4.5 to 6.5). They do suffer from serious diseases, however, the most devastating of which is apple scab, *Venturia inaequalis*. This disease in wet seasons results in severe defoliation. Other diseases include cedar apple rust, which is prevalent on native crabapples, and fireblight. Certain species and cultivars exhibit resistance to these diseases.

Crabapples have been used in parks, malls, containers and along streets. One of the primary concerns along streets is the fruit which can prove hazardous to traffic because of its slick flesh; not only are the decomposing fruits unsightly, but they attract wasps which may sting passing pedestrians. Crabapples tend to be low-branched and wide-spreading, characteristics that may interfere with traffic movement. The major maintenance problem is the necessity for periodic removal of suckers and watersprouts.

The following crabapples represent some of the better types that might be used for various urban landscape purposes. Our selection is based on composite considerations of growth habit, flower, fruit, foliage and disease resistance.

*Malus* × *atrosanguinea*

## Carmine Crabapple

A low-branching, wide-spreading type, this forms a dense mound of lustrous, dark green foliage. The rose-pink flowers open in May. The dark red, ½-inch-diameter fruit is seldom produced in quantity and consequently is not a maintenance problem. It is very resistant to apple scab. Ultimate tree height is 15-20 feet with a comparable spread.

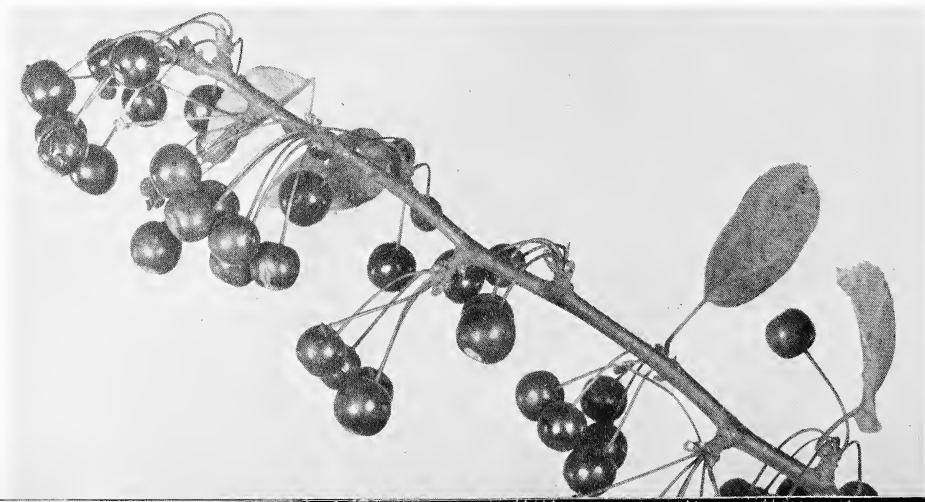
*Malus baccata* 'Columnaris'

## Columnar Siberian Crabapple

This is one of the few distinctly upright-growing crabapples offering good disease resistance. Flowers are white and fruits are yellow with a red blush. The authors have not observed heavy flowering on this cultivar, which will grow 20-30 feet (to 50 feet) high and 6-10 feet wide.

*Malus* 'Coralburst'

A small, dainty, compact crabapple that is ideal for use in containers, it forms a symmetrical, rounded crown and bears double rose-pink flowers. The foliage is dark green and slightly susceptible to apple scab; fruits are sparse.



*Malus* 'Donald Wyman'

This is one of the best crabapples the authors have observed. The foliage is lustrous, dark green, and highly resistant to disease. The annual white flowers are followed by  $\frac{3}{8}$ -inch-diameter, cherry-red fruits that persist throughout most winters. The tree grows 20-25 feet high and 25-30 feet wide. It is easily rooted from cuttings.

*Malus floribunda*

## Japanese Flowering Crabapple

This often has been called the standard by which other crabapples are judged. The dark green foliage is slightly susceptible to scab and mildew. The species is rated moderately susceptible to fire blight. The deep pink to red buds open to single white flowers. The  $\frac{3}{8}$ -inch-diameter yellow and red fruits are not as ornamental as are the fruits of 'Donald Wyman'. The habit is variable but the finest trees assume a low-branched (almost mushroom-like), wide-spreading canopy. The height ranges between 15-25 feet.

*Malus hupehensis*

## Tea Crabapple

This is one of the most distinctive crabapples because of its vase-shaped growth habit and long arching branches. The lustrous, dark green foliage is scab free but fire blight can be severe. The pink buds open to white. The  $\frac{3}{8}$ -inch-diameter greenish-yellow to reddish fruit is not showy. The flowering pattern is alternate. Size varies from 20-25 feet in height and 20-25 feet in width.

*Malus* 'Red Jade'

This is a graceful weeping form with lustrous, dark green foliage. The foliage is listed as being moderately susceptible to scab and powdery mildew but the authors have not observed significant foliar problems. The tree grows 15-20 feet high. It is a superlative choice for containers where the branches can hang over the sides. The flowers are white and the  $\frac{1}{2}$ -inch-diameter fruits are glossy red. 'Red Jade' tends to bear in alternate years.

*Malus sargentii*

## Sargent Crabapple

Low-growing, broad-spreading, this crabapple bears white flowers and  $\frac{1}{4}$ -inch-diameter dark red fruits. The deep green foliage is essentially disease free and may turn rich yellow-brown in fall. The ultimate height ranges between 8 and 10 feet and spread may double the height. A splendid choice for containers or mass plantings, this is an annual-flowering type.

*Malus* 'Snowcloud'

Upright-oval-shaped, this cultivar is well suited for street use. The foliage is lustrous green and disease free. The flowers are white and, interestingly, the plant sets no fruit. Ultimate height will range between 15 and 25 feet with spread about one-half the height.

*Malus* 'Snowdrift'

Snowdrift is often described as one of the best crabapples for street tree use. The foliage is lustrous dark green and slightly susceptible to scab. It has been listed as fire blight susceptible. The 1-inch-diameter white flowers are effective and the small orange-red fruit is not messy. The habit is oval to oval-rounded with ultimate height approaching 20 feet.

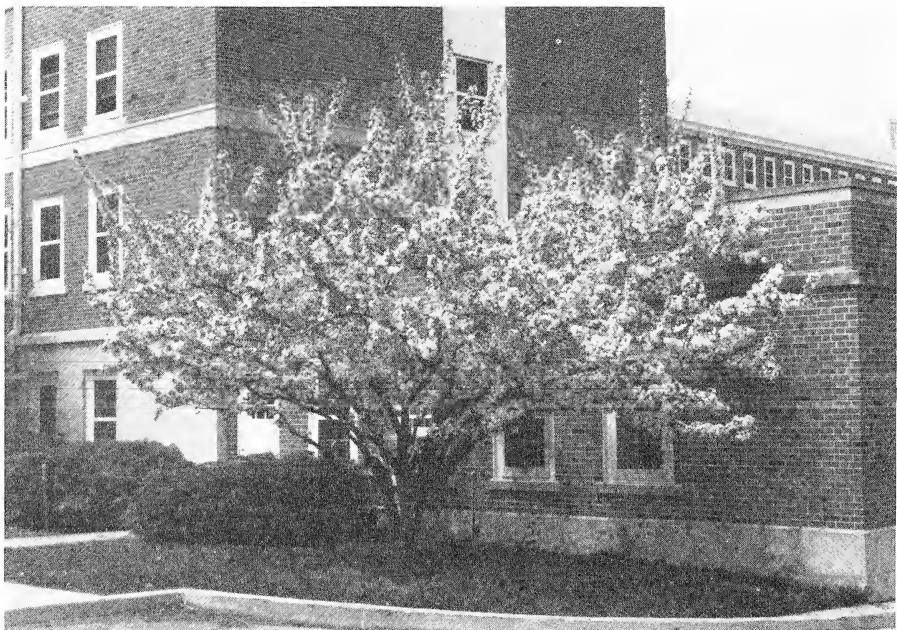
*Malus tschonoskii*

## Tschonoskii Crabapple

*Malus tschonoskii* is one of the larger crabapples and may grow 30-40 feet tall. The medium green foliage turns bronze and orange-red in fall; it is slightly susceptible to scab. The single white-pink flowers and the sparse russet-green fruits are not effective. The new foliage is silver-gray and is beautiful. Habit of the plant is upright-oval.



Above: *Malus sp.*; below: *M. hupehensis*





*Above: bark and blossoms of Malus floribunda; below: M. micromalus*



***Platanus* × *acerifolia*****London Plane Tree****HEIGHT:** 70-100 feet**SPREAD:** 60-80 feet**HABIT:** pyramidal in youth, becoming open and wide-spreading with maturity**ZONE:** 4**ENVIRONMENT:** full sun; adaptable to urban conditions and soil extremes; pH adaptable; drought tolerant

The species has been used as a street tree in many cities and has literally overgrown its boundaries. As a tree for parks, open spaces, golf courses or other large areas, it deserves consideration. The medium green foliage is not particularly outstanding in summer or fall. The creamy-olive bark adds winter interest. Abiotic (non-biological) stresses are known to induce greater biological stresses (diseases and insects) and this may be part of the reason for the increased number of diseases and insects reported on London plane trees in recent years. Assets include strong structure, rapid growth and dependability in difficult urban locations. Liabilities include litter from large leaves and exfoliating bark, and the massive size of mature specimens. Pests and diseases include lace-wing fly and variable resistance to *Anthracnose*. 'Bloodgood' is supposedly a superior clone that tolerates heat, drought, soil compaction, and severe pruning, while being a rapid grower. It has been reported as being extremely susceptible to ozone. Recent reports after the winter of 1976-'77 and '77-'78 have noted extensive winter damage in the form of stem dieback and trunk splitting. *Platanus* × *acerifolia* has proven itself to be a fine choice for container plantings.





*Prunus sargentii*

Sargent Cherry



HEIGHT: 30-40 feet

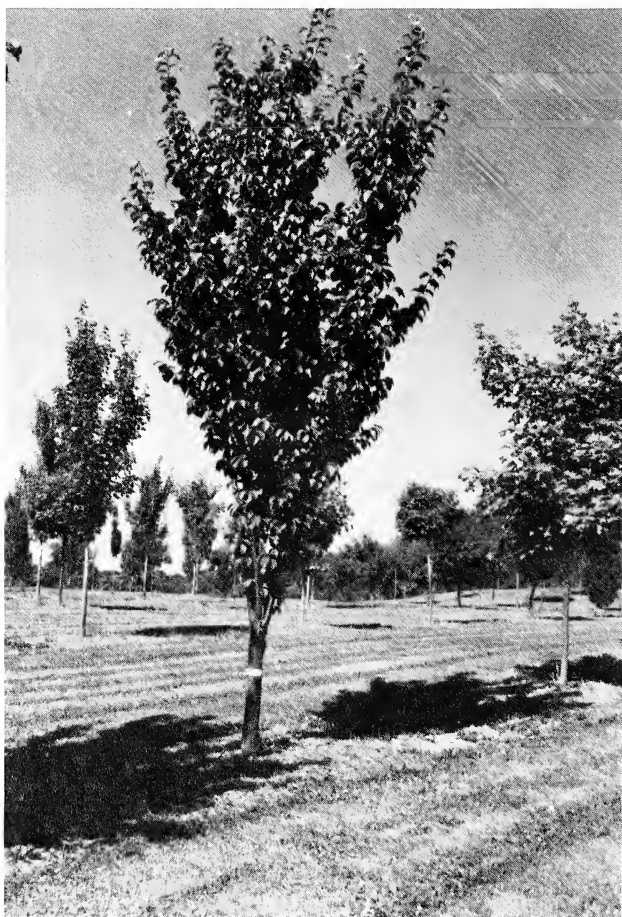
SPREAD: 20-40 feet

HABIT: upright, ascending, vase-shaped in youth, becoming more rounded with age

ZONE: 4

ENVIRONMENT: full sun; moist, well-drained, acid soil

Cherries, in general, are not tolerant of extreme stress and, therefore, are not suitable for streets or urban conditions. This is probably the best ornamental cherry, with its dark green foliage that changes to yellow, brown and reddish-purple in the fall. The single, pink, short-lived flowers are produced in axillary clusters in April-May before the foliage develops. The rich, polished, reddish-brown bark provides seasonal interest. Overall, *Prunus sargentii* is a good tree that is probably best utilized where poor soils and stresses are minimal. 'Columnaris' is an upright form with a thin "beer-glass" shape; it has the same ornamental assets as the species.

*Prunus sargentii* 'Columnaris'



*Pyrus calleryana* 'Bradford'

## Bradford Pear

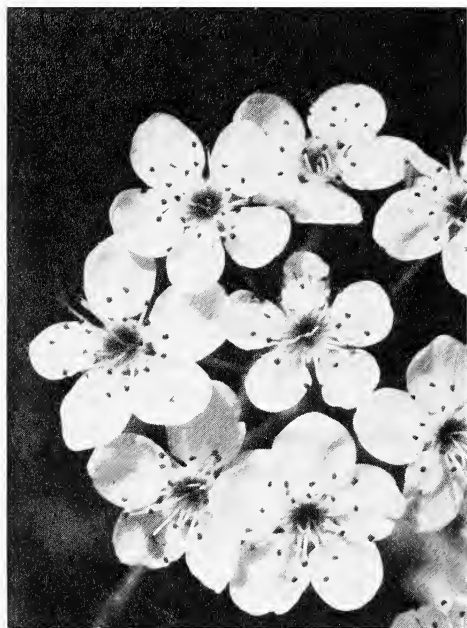


HEIGHT: 30-50 feet  
 SPREAD: 20-35 feet  
 HABIT: pyramidal to pyramidal-  
 rounded

ZONE: 4  
 ENVIRONMENT: full sun; extremely  
 adaptable to varied soils, pH, and  
 pollutants

This very popular cultivar has been overused for street and city plantings because of its uniform habit and urban adaptability. The lustrous, dark green leaves hold late and may color reddish-purple in the fall; 'Bradford' was still in fall color when Boston had its first snow on November 21, 1978. The malodorous, white flowers appear before the leaves in late April and early May and are followed by small russet-colored fruits which are never a maintenance problem. Graft compatibility problems are becoming increasingly evident and twenty-year-old trees may show decline. Cultivars should be budded on *Pyrus calleryana* seedlings since those budded on *P. communis* soon decline. Some nurserymen

have had success rooting cuttings and this approach alleviates the incompatibility problems. Older specimens in the parking lot at the National Arboretum are splitting at multiple-stemmed crotches. 'Aristocrat', 'Chancellor' (upright form), 'Chanticleer', 'Select', and 'White House' (upright form) offer good ornamental characteristics.



### *Pyrus fauriei*

HEIGHT: 20 feet or more

SPREAD: 20 feet

HABIT: dense, broad pyramidal to rounded

ZONE: 5

ENVIRONMENT: full sun; adaptable to varied soils; shows great potential for urban situations

This plant is often listed in the nursery trade as *Pyrus calleryana* 'Fauriei'. The white flowers are similar to those of 'Bradford' and open in late April to early May. The lustrous, dark green leaves turn orange, scarlet and reddish-purple in fall. The plant develops a symmetrical, dense crown at an early age. Plants tried in Ohio cities have performed well in 4- by 4-foot sidewalk cuts. *P. fauriei* appears to be as city tolerant as 'Bradford' and would make a good street tree for that reason.

*Quercus palustris*

## Pin Oak



HEIGHT: 50-70 feet

SPREAD: 25-40 feet

HABIT: strongly pyramidal, usually with a central leader; the lower branches pendulous, the middle horizontal, and the upper upright

ZONE: 4

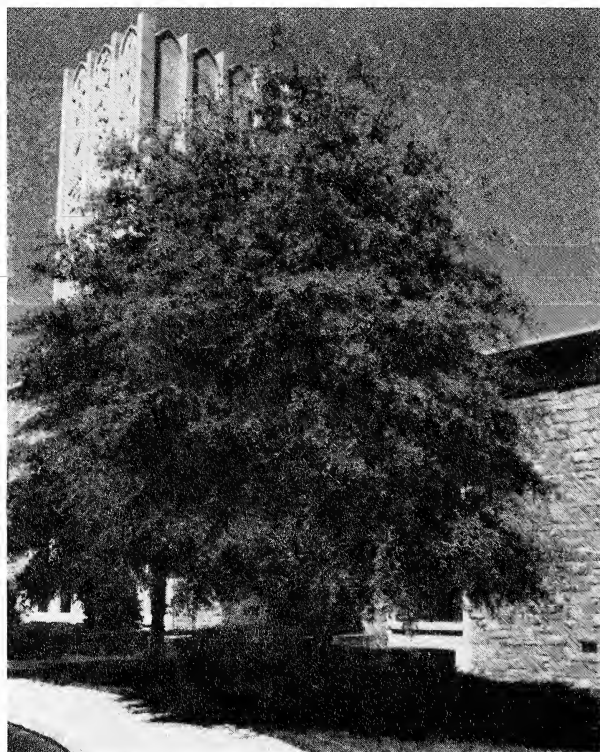
ENVIRONMENT: full sun; adaptable to moist or dry situations; intolerant of alkaline soils; tolerant of city conditions

The most popular oak in the East and Midwest for street and lawn plantings, pin oak is transplanted more readily than most oaks. Its lustrous, dark green foliage turns russet-red to red in fall and often holds through winter on young plants. The species is tolerant of wet soils and, in the wild, is found on wet clay flats where water may stand for several weeks. It seems equally at home in sandy or clayey soils. A superior performer in urban situations, *Quercus palustris* has been used liberally as a street tree in many cities. In general, it makes a good street tree, although its pendulous lower branches may obstruct walks and roadways and must be removed on a regular basis. The cultivars 'Crownright' and 'Sovereign' have lower branches that do not droop but are borne at a 90° to 45° angle to the main leader. These cultivars are prone to graft incompatibility problems.



*Quercus phellos*

Willow Oak



HEIGHT: 40-60 feet (and larger)  
 SPREAD: 30-40 feet  
 HABIT: distinctly pyramidal when  
 young, becoming oval-rounded with  
 age

ZONE: 5  
 ENVIRONMENT: full sun; moist, acid,  
 well-drained soils; transplant in spring

*Quercus phellos* is the most graceful and refined of the oaks and certainly the most popular in many parts of the temperate South. This is the pin oak of the southern states. It is seen in street tree plantings, residential landscapes, and parks. The small, narrow, linear leaves provide a willowy texture that most people would not associate with the genus *Quercus*; leaf color ranges from rich green in summer to yellow and russet-red in fall. The tree is relatively fast growing and may average two feet a year over a ten- to twenty-year period. The species is quite disease resistant. The small acorns are relished by birds and animals and do not create a litter problem. Density and twiggyiness make this tree a maintenance nightmare for arborists, however. In the wild, *Q. phellos* is found on poorly drained, loamy or clayey soils but performs best in acid, moist, well-drained situations. It transplants readily in spring but is not hardy where temperatures drop below  $-10^{\circ}$  to  $-15^{\circ}\text{F}$ . Only trees from the northern limit of its native range should be planted in Zone 5.

### *Quercus robur* 'Fastigiata'

### Upright English Oak



HEIGHT: 50-60 (80) feet

SPREAD: 15-20 feet

HABIT: distinctly upright branching  
and dense; one of the handsomest  
columnar trees

ZONE: 4

ENVIRONMENT: full sun; moist, well-  
drained soil; more adaptable to  
drought and high pH than many oaks;  
wind tolerant

The species is a splendid ornamental with wide-spreading branches and dark green foliage, but is seldom used in the United States for landscaping. However, 'Fastigiata' is a popular upright-growing cultivar that has found wide acceptance for streets, malls, containers and restricted growing areas. The dark green foliage holds late (November) and does not develop good fall coloration. The leaves often are attacked by lace-wing fly and may contract mildew in wet weather. Considerable variation in habit and mildew susceptibility occurs because the plants are often grown from seed. Nurserymen have indicated that upright habit is present in 80 to 90 percent of the seed-grown progeny. Among fastigiate trees, this is one of the most pest free and long-lived. *Quercus petraea* 'Columnaris' is similar to *Q. robur* 'Fastigiata' in growth habit but differs by being more resistant to mildew and lace-wing fly. Both are excellent landscape plants with *Q. robur* 'Fastigiata' being the more common in the American landscape trade.

***Quercus rubra*****Red Oak**

HEIGHT: 60-75 feet

SPREAD: 40-60 feet

HABIT: rounded in youth and old  
age

ZONE: 4

ENVIRONMENT: full sun; prefers a  
sandy loam soil that is well-drained  
and acid; withstands pollution; not  
tolerant of extremely wet or high  
pH soils



*Quercus rubra* (often incorrectly listed as *Q. borealis*) is used widely for streets, parks and residential properties. It transplants readily, thus facilitating its extensive use. The lustrous, dark green leaves may turn rich brown, russet-red, or red in the fall. Both *Q. rubra* and *Q. palustris* are structurally strong, long-lived trees. Their acorns may prove to be a litter problem, although squirrels generally destroy them even before they are mature. Scale may constitute a serious pest. Both species are native trees that are always in vogue with landscape planners and seldom fail if given proper soil. Extensive street plantings of red oak have survived and flourished despite repeated abuse from pedestrians, cars, salts and air pollutants.

*Sophora japonica*

**Japanese Pagoda-tree or  
Scholar-tree**



HEIGHT: 50-75 feet

SPREAD: 50-75 feet

HABIT: densely rounded in youth,  
usually rounded to broadly rounded  
at maturity

ZONE: 4

ENVIRONMENT: full sun; once estab-  
lished, tolerates heat and drought; pH  
adaptable



Although an excellent tree, *Sophora japonica* may be too large for most street plantings and better suited as a park or large area specimen. The rich green foliage holds late into fall. Creamy-yellow fragrant flowers cover the plant in August. The fruits are a bright yellow-green and offer late summer and fall colors. The tree tends to be messy, dropping leaves, flowers, fruits, and twigs throughout much of the year. 'Regent' was selected for its more uniform habit, faster growth, straighter habit, and ability to flower at a young age.

### *Tilia cordata*

### Littleleaf Linden



HEIGHT: 50-70 feet

SPREAD: 25-50 feet

HABIT: pyramidal in youth, pyramidal-oval to oval-rounded at maturity

ZONE: 4

ENVIRONMENT: full sun; a good city tree since it withstands compacted soils, drought, heat, and air pollutants; pH adaptable

This species and its numerous cultivars rank at the top of the street tree list, as evidenced by their wide use throughout the East and Midwest. In some cities, the use of this species has almost assumed monoculture status. Since it performs well under stress, it has been pushed to the forefront of street trees. The dark green (often lustrous) foliage seldom colors well in fall. In the Arnold Arboretum's linden collection only two species, *Tilia petiolaris* and *T. tomentosa*, developed good yellow autumn color. The fragrant, yellowish-white flowers produced in abundance during June are very attractive to bees; this could prove troublesome in parks and on streets where people are present. Structurally the trees are quite sturdy and their relatively compact habit allows use where lateral space is limited. Japanese beetles may disfigure the foliage, while aphids secrete honeydew upon which sooty mold, a fungus, grows and proliferates, making the trees unsightly. Basal suckers are troublesome and may have to be removed. 'Greenspire', 'Chancellor', 'Rancho', and 'June Bride' are among the better cultivars.

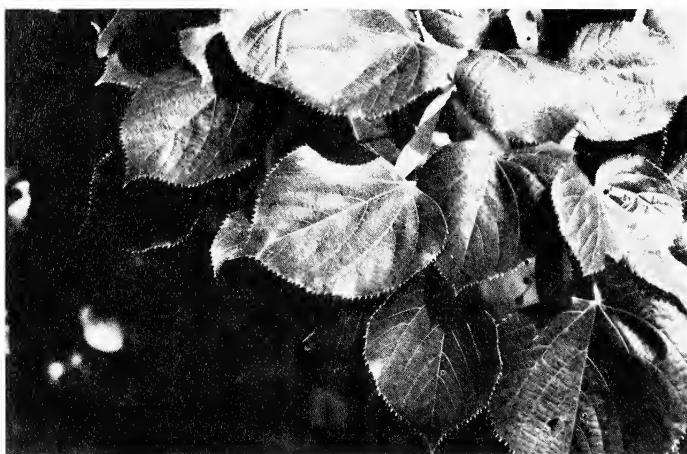
***Tilia* × *euchlora* 'Redmond'**

**Redmond Linden**



HEIGHT: 30-50 feet  
 SPREAD: 30-40 feet  
 HABIT: densely pyramidal

ZONE: 4  
 ENVIRONMENT: similar to *T. cordata*



This is an extremely vigorous cultivar of hybrid origin that in sixteen years averaged 15 feet in height and 10-inch trunk diameter at the Horticultural Research Center of the University of Minnesota; trees on the University of Illinois campus exhibited a similar vigor. The large, dark green leaves form a solid canopy. Creamy-yellow flowers appear in June. The tree may suffer from the same problems as *Tilia cordata*, but it tends to grow faster and has similar ornamental characteristics. It makes a splendid street, park, campus, or residential tree. The tree is slightly coarser than *T. cordata* or *T. × euchlora*.

### ***Tilia tomentosa***

### **Silver Linden**



HEIGHT: 50-60 feet

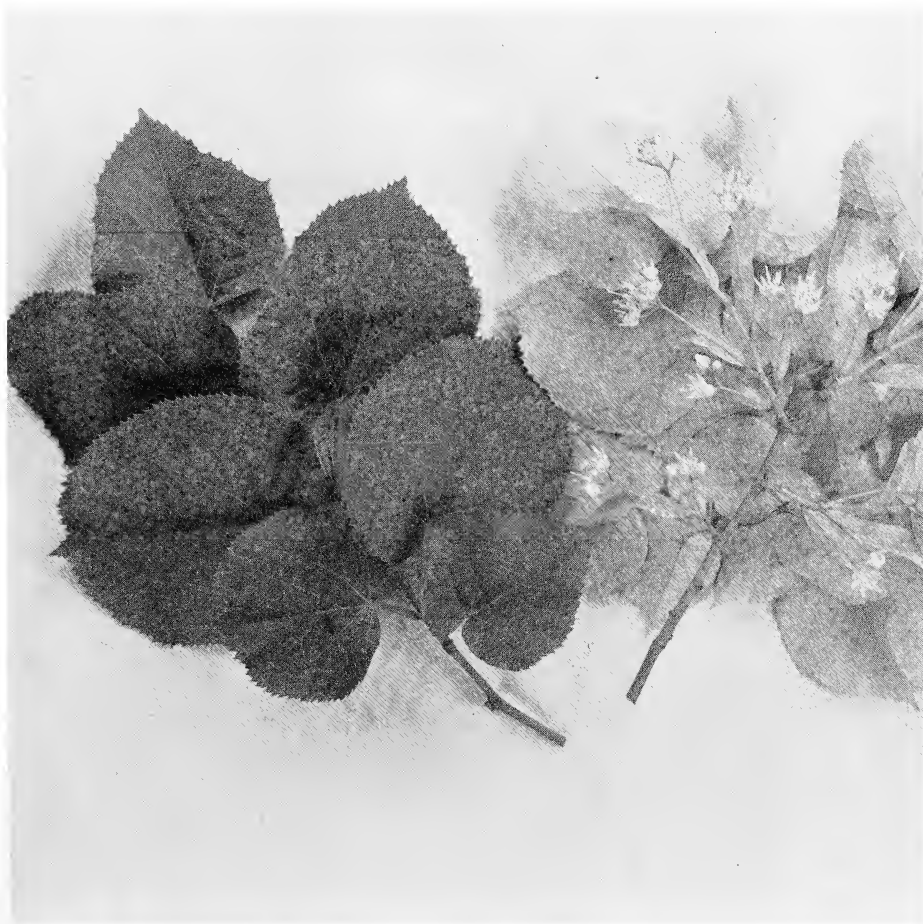
SPREAD: 25-45 feet

HABIT: pyramidal in youth, maintaining the most upright branching pattern of the linden species

ZONE: 4

ENVIRONMENT: see *T. cordata*; may not be suitable for heavily polluted areas

This species and *Tilia petiolaris* are the most majestic and ornamental members of the genus. The upper leaf surface is a lustrous, dark green, while the lower surface is covered with a silvery mat of woven hairs that make the leaves especially ornamental when buffeted by wind. The creamy-yellow fragrant flowers are the last to open among those of cultivated lindens. The bark of *T. tomentosa* is often a smooth gray in youth. *Tilia petiolaris* is similar, except that the branches take on a slightly pendulous aspect. Both developed good yellow fall color at the Arnold Arboretum in 1978. Both are beautiful trees and their use is certainly warranted. 'Fastigiata' is more narrow in shape than the species, and 'Princeton' is a fine oval form. Seedlings vary enormously and most have very poor forms.



*Ulmus parvifolia*

Chinese Elm



HEIGHT: 30-50 feet

SPREAD: 30-50 feet

HABIT: gracefully rounded; some trees assume a vase-shaped outline

ZONE: 5

ENVIRONMENT: full sun; tolerant of heat, compaction, and drought; pH adaptable



When elms are being considered, this might well be the species to utilize. The small, lustrous, dark green leaves hold late into fall. The bark on old trunks develops a beautiful mottled combination of green, orange, and brown, while the trunks become fluted with age. The wood is much stronger than that of Siberian elm, which is prone to breakage in ice storms. *Ulmus parvifolia* shows a high degree of resistance to Dutch elm disease and consequently has been used from Massachusetts to California and Minnesota to Georgia with success. Finer textured than most elms, it should not be confused with *U. pumila*, Siberian elm, which is an inferior and basically worthless landscape species. *Ulmus parvifolia* shows good tolerance to parking lot environments, infertile soils, drought and wind. In California and areas of the deep South, the cultivars 'Sempervirens', 'Drake', and 'True Green' are semi-evergreen to evergreen.

### ***Zelkova serrata***

### **Japanese Zelkova**



HEIGHT: 50-60 feet  
 SPREAD: 50-60 feet  
 HABIT: low-branched, vase-shaped tree

ZONE: 4  
 ENVIRONMENT: full sun; drought and wind tolerant; pH adaptable





Often touted as an American elm replacement, which it certainly is not, *Zelkova* never develops the tall trunk and the pendulous outer branches that give such majestic form to the American elm. The dark green summer foliage changes to yellow, brown, or wine-red in fall and the bark on older trunks develops an exfoliating nature. Seed-grown trees often develop crooked trunks and require considerable staking and pruning. Susceptibility to Japanese beetles may be a problem, and the species is only moderately resistant to Dutch elm disease. Rapidly becoming a popular tree, it is being utilized for street and city plantings, especially in the Northeast. 'Village Green' appears to be a superior cultivar that develops a straight trunk. The dark green foliage turns a rusty-red in the fall, and the tree is supposedly much hardier than the type. It is performing well in the Arnold Arboretum and has grown 2-3 feet in a single season. 'Parkview' was selected for its good vase shape. Neither cultivar has proven hardy at the University of Wisconsin Arboretum, Madison, Wisconsin ( $-25^{\circ}\text{F}$ ).



## SECONDARY LIST

Several well-known and commonly used plants appear in this category, and it is because of widespread use that we are aware of one or more major problems that detract from the value of a specific tree. These include difficulties in transplanting, intolerance of moisture stress, weak structure, susceptibility to major diseases or insect pests, and the need for occasional pruning to produce a satisfactory canopy.

A problem associated with a particular tree often results from culture, placement, or long-term maintenance. If the limitation is known in advance, the plant can be utilized in a landscape situation where the problem will be minimal if, in fact, it develops at all.

*Acer ginnala*

## Amur Maple



HEIGHT: 15-20 feet

SPREAD: 15-20 feet

HABIT: large shrub or small tree of rounded outline

ZONE: 2

ENVIRONMENT: full sun to light shade; well-drained soil, dry soil tolerant; pH adaptable

This species is one of the finest small, shrubby maples but it is extremely variable in ornamental traits. The summer foliage may range from dull green to lustrous dark green, while fall color varies from yellow to red. On some trees the fruits become red in summer. Amur maple can be used in containers; it withstands heavy pruning and makes a reasonable hedge. If a single-stemmed tree is desired, considerable pruning is necessary. Irregular growth habit precludes uniform street tree plantings, but for difficult cold sites this is a worthwhile choice. A recent research report from Ohio indicated that the species is quite susceptible to *Verticillium* wilt.

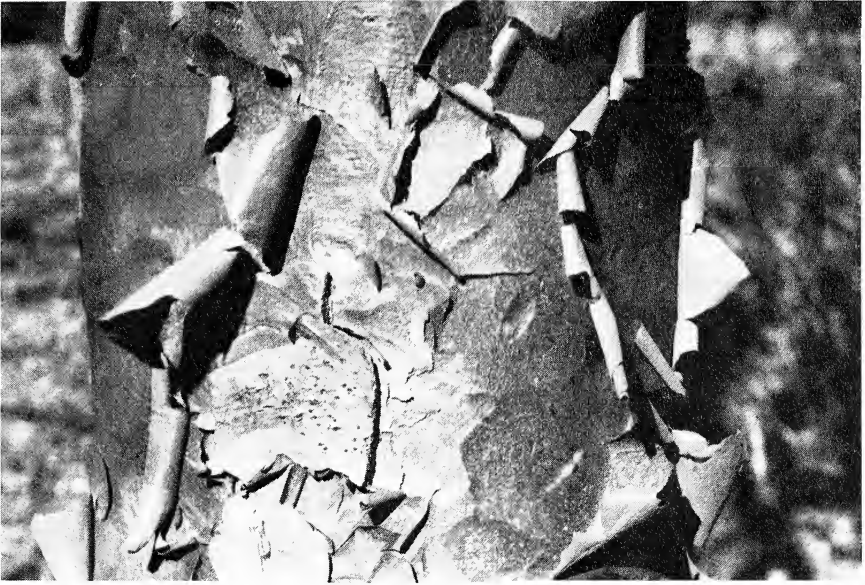
### *Acer griseum*

### Paperbark, Cherrybark Maple



HEIGHT: 20-40 feet  
 SPREAD: 10-40 feet  
 HABIT: upright-oval to rounded

ZONE: 4  
 ENVIRONMENT: full sun to light shade; best growth in well-drained, acid soils, but does well in clay situations



*Acer griseum* is a small tree with rich brown exfoliating bark and leaves that become russet-red to red in fall. Propagation difficulties, slow growth, and lack of commercial availability limit its widescale use. The colorful bark may prove attractive to vandals in urban situations. Paperbark maple is best as a small, specimen lawn tree. It is slow growing and somewhat variable when seed-grown. Structurally, it is one of the strongest medium-sized maples and does not suffer from ice and snow damage.

***Acer maximowiczianum***  
(*A. nikoense*)

**Nikko Maple**



HEIGHT: 20-30 feet

SPREAD: 20-30 feet

HABIT: vase-shaped, round-headed,  
low branching

ZONE: 4

ENVIRONMENT: full sun to light  
shade; loamy, moist, slightly acid soil

This is one of the best small maples, yet is seldom used in American landscapes. The rich green foliage turns a fine red in fall. Smooth gray bark adds winter interest. Nikko maple could be used in planters and under utility wires. It has no serious insect or disease problems.

***Acer saccharum***

**Sugar Maple**



*Acer saccharum* 'Newton Sentry'

HEIGHT: 60-75 feet  
 SPREAD: 40-75 feet  
 HABIT: upright-oval to rounded,  
 quite dense-headed

ZONE: 3  
 ENVIRONMENT: full sun; moist,  
 well-drained, acid soil

Sugar maple ranks at the forefront of shade trees but is not a good choice for streets or urban landscapes. The dark green foliage changes to brilliant yellow, orange and red. The species is susceptible to *Verticillium* wilt, salt, air pollutants, drought and compaction. Unfortunately, it is still being utilized in high-stress situations. 'Green Mountain' is a dark green, leathery-leaved selection that is quite heat tolerant and performs better than the species in dry, restricted growing areas.

## *Acer tataricum*

## Tatarian Maple



HEIGHT: 15-20 feet (25 feet)  
 SPREAD: similar to height  
 HABIT: small, rounded, low-branched  
 tree or large, bushy shrub

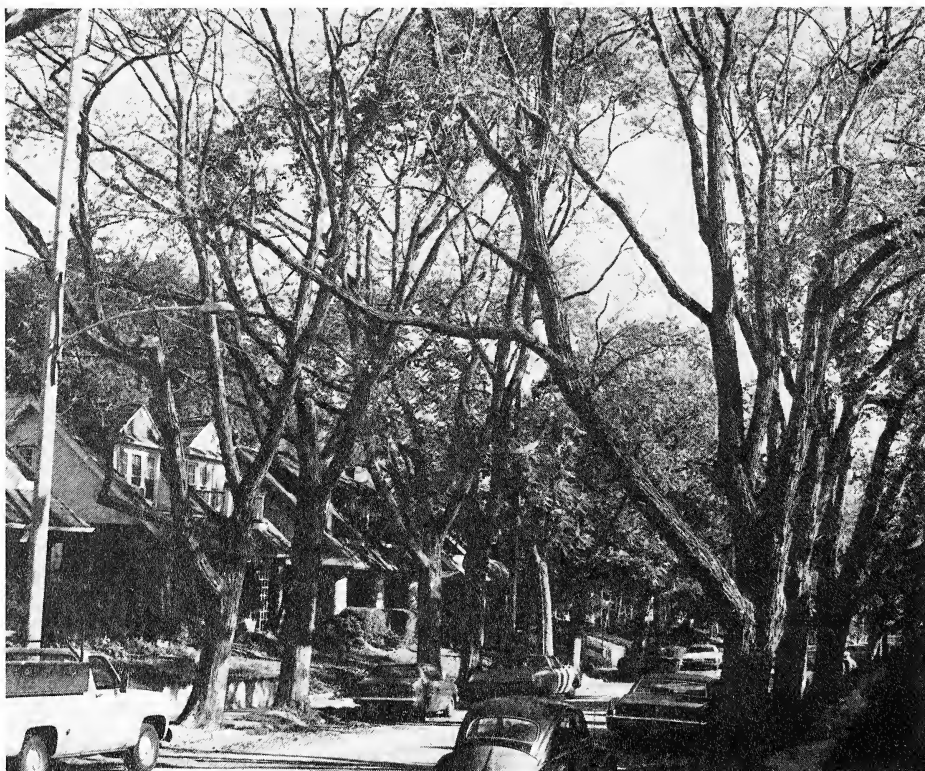
ZONE: 4  
 ENVIRONMENT: full sun; adapts to  
 a wide range of soil conditions; pH  
 adaptable



Very similar to *Acer ginnala* and often confused with it, this species is extremely variable, since it is grown from seed. Some trees have light green foliage; others, lustrous, almost leathery, dark green leaves. Autumn color varies from yellow to orange-red. The fruits turn a good red during July or August, and the gray bark is relatively smooth. *A. tataricum* needs special pruning to head-up for clearance along streets and it is weak-wooded. Adaptability to dry, compacted soils is its principal asset, suggesting that it would adapt to container culture.

### *Cedrela sinensis*

### Chinese Toon Tree





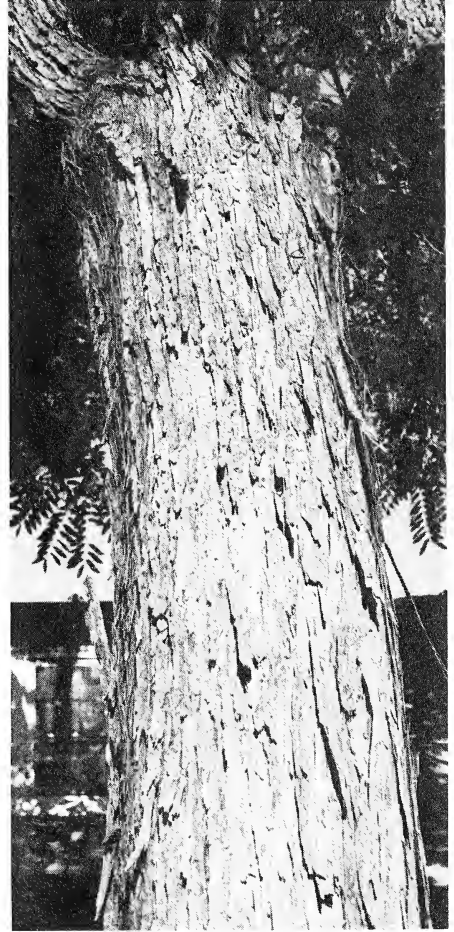
HEIGHT: 50-70 feet

SPREAD: 30-50 feet

HABIT: upright and spreading, extremely irregular in habit, varying from multiple- to single-stemmed

ZONE: 5

ENVIRONMENT: full sun; well-drained soil; pH adaptable

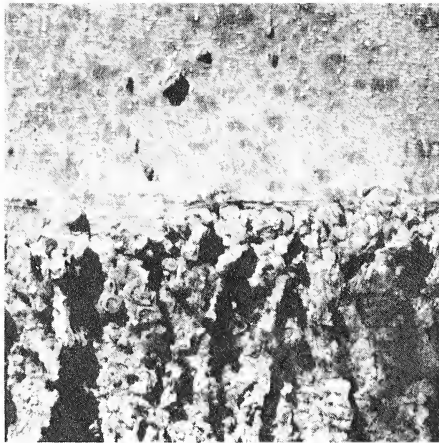


*Cedrela* has long been used successfully as a street tree in Paris, France, and one street in Philadelphia has seventy-year-old plantings. The species' habit is extremely variable and pruning would be necessary to produce single-stemmed, straight-trunked trees. The large, pinnately compound leaves turn rich yellow in autumn, and the shaggy, orange-brown bark is interesting in winter. *Cedrela* is a fast grower but may be slow to recover after transplanting. Plants may develop suckers that would have to be removed. The foliage has an onion-like odor when crushed, and can be eaten during spring.



*Celtis laevigata*

Sugarberry, Sugar Hackberry



HEIGHT: 60-80 feet

SPREAD: 60-80 feet

HABIT: rounded to broad-rounded  
with spreading, often pendulous  
branches

ZONE: 5

ENVIRONMENT: full sun; moist or  
dry soils; pH adaptable

*Bark of Celtis laevigata grafted on C.  
occidentalis*

A popular lawn and street tree in the southern states, *Celtis laevigata* is resistant to both the nipple galls and witches-brooms that are so troublesome on *C. occidentalis*. The leaves are lustrous green, and the bark has fewer corky protuberances, in some situations being almost smooth. In comparison with specimens of *C. jessoensis* and *C. occidentalis* at the Arnold Arboretum, *C. laevigata* does not appear to be vigorous. Selections must be made before this tree can be recommended for street and city use in northern areas. It is tolerant of polluted conditions and is more graceful than *C. occidentalis* in outline.

*Cercidiphyllum japonicum*

**Katsura Tree**



**HEIGHT:** 40-60 feet

**SPREAD:** variable

**HABIT:** pyramidal to wide-spreading,  
significantly variable

**ZONE:** 4

**ENVIRONMENT:** full sun to partial  
shade; responds best to rich, moist,  
well-drained, slightly acid soils



A most beautiful tree, this species unfortunately is susceptible to drought and somewhat slow to establish after transplanting. It needs consistent moisture throughout the growing season. Staminate trees are said to be more upright than pistillate ones, but this is not universally true. The bluish-green leaves turn yellow to apricot in fall and it is then that the leaves give off a sweet spicy aroma. The brown bark develops a slightly shaggy character. *Cercidiphyllum* is not a good tree for compacted, droughty soil, but where parkways are sufficiently wide it deserves consideration. Older mature specimens may split at low level crotches in ice and snow storms. This species is insect and disease free, and, where space permits, it makes a splendid avenue tree. A planting flanks either side of a long drive at Regis College, Weston, MA, and rivals any street lined with American elms for grace and beauty.

### *Cladrastis lutea*

### American Yellowwood



HEIGHT: 30-50 feet  
 SPREAD: 35-45 feet  
 HABIT: rounded, rather handsome  
 outline

ZONE: 5, perhaps 4  
 ENVIRONMENT: full sun; well-  
 drained soil but best growth is at-  
 tained in moist soils; pH adaptable

This native American species, when properly grown, is among the handsomest of all trees. The new foliage emerging yellowish-green changes to a darker green at maturity and the fall color may be a golden-yellow. The creamy-white, fragrant flowers are borne in 8- to 14-inch-long pendulous, wisteria-like panicles



in May/June. Flowering tends to be cyclic with excellent flowering occurring every third year. The smooth gray bark resembles that of beech (*Fagus*). American yellowwood develops bad crotches and is subject to ice and physical damage. Due to excessive sap flow, it must be pruned in summer. The species shows fair drought tolerance and is able to fix atmospheric nitrogen; both features permit survival in poor soils. It should be reserved for parks and other areas where adequate space is available.

***Crataegus laevigata* 'Paulii'**  
(formerly *C. oxyacantha* 'Paulii')

**Paul's Scarlet Hawthorn**

HEIGHT: 15-20 feet

SPREAD: 12-20 feet

HABIT: low-branched, round-topped  
tree with minimal thorn development

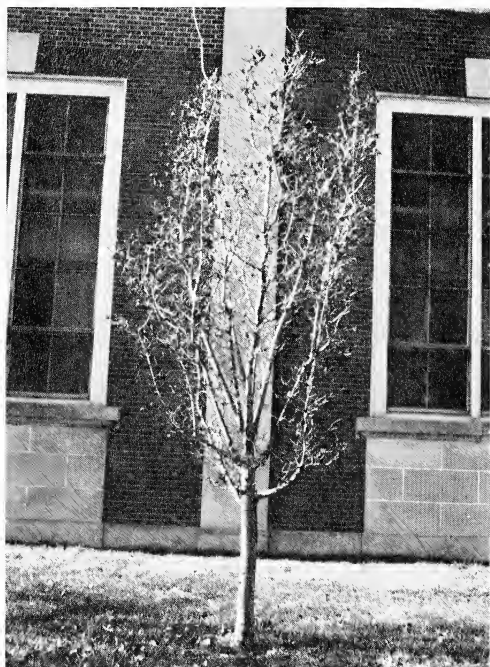
ZONE: 4

ENVIRONMENT: full sun; clay and  
sandy soils; pH adaptable

This is the most popular of the English hawthorn cultivars and probably the most insect and disease susceptible. Leaf spot may cause severe defoliation by June or July. The rose-red, double flowers are quite handsome in May but otherwise the plant has little to offer. *Crataegus crus-galli*, *C. phaenopyrum*, *C. punctata* 'Ohio Pioneer', and *C. viridis* 'Winter King' are all superior to 'Paulii'.

*Crataegus* × *lavallei*

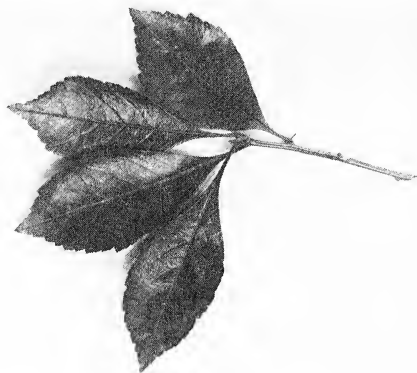
Lavalle Hawthorn

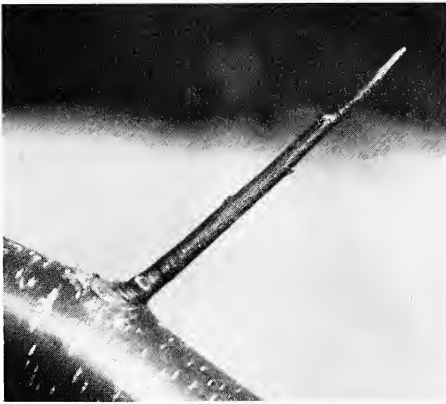


HEIGHT: 20-25 feet  
 SPREAD: 15-20 feet  
 HABIT: oval-headed

ZONE: 5  
 ENVIRONMENT: similar to that of  
*C. phaenopyrum*

At one time considered a promising hawthorn, this hybrid has lost favor in recent years. The lustrous, dark green foliage usually does not color well in fall. White flowers in May are followed by  $\frac{3}{4}$ -inch-long brick-red fruits that are often sparse and tend to be hidden by the foliage which holds late. The plants tend to show irregular shapes and may not blend well in street tree plantings. The stems are waxy green and essentially thornless. Lavalle hawthorn is rather coarse in both summer and winter and, in comparison with *Crataegus crus-galli*, *C. phaenopyrum*, or *C. viridis* 'Winter King', is a poor choice.



*Elaeagnus angustifolia***Russian-olive**

**HEIGHT:** 15-20 feet (30 feet)

**SPREAD:** 15-20 feet

**HABIT:** large shrub or small tree of rounded outline; often open and airy

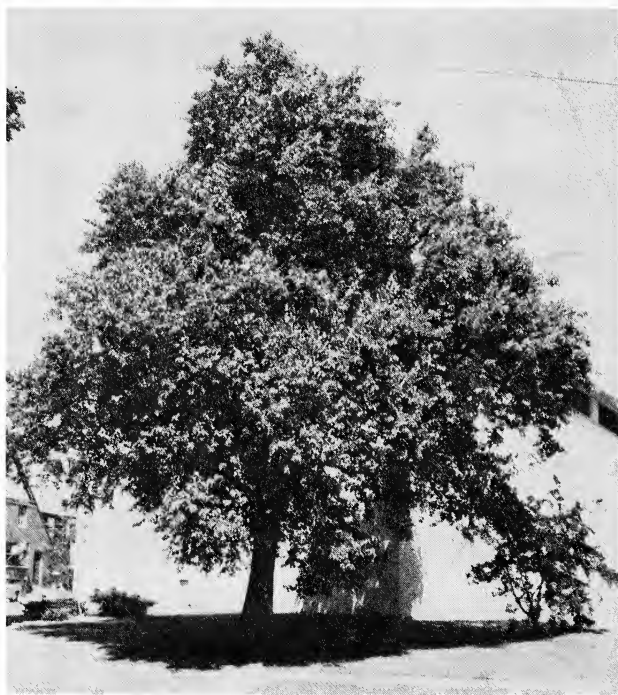
**ZONE:** 2

**ENVIRONMENT:** full sun; saline tolerant; dry or moist soils; tolerates heat; pH adaptable

This species has been overplanted and in recent years has lost favor among landscape planners. It is one of the few deciduous woody plants that offers silvery-gray foliage. The habit is extremely variable, ranging from a sprawling shrub to a 30- to 40-foot tree. The yellowish-white, fragrant flowers develop in May. *Verticillium* wilt and canker problems limit its use and it has been removed from the acceptable tree list in many cities. Extremely tolerant of cold, dry, infertile, and saline conditions, it does well in containers. Salinity studies have shown that Russian-olive is about as tolerant of salt as *Rosa rugosa* which forms the front line of defense along the coast of Cape Cod.

*Maclura pomifera*

## Osage-orange



HEIGHT: 20-40 feet

SPREAD: 20-40 feet

HABIT: develops a short, low trunk  
and low, irregular, rounded crown of  
stiff, spiny, interlacing branches

ZONE: 4

ENVIRONMENT: full sun; thrives on  
adversity; pH adaptable

An adaptable native tree that needs to be tried under city conditions, Osage-orange has shiny, bright green foliage that often turns a clear yellow in fall. The fruits on pistillate (female) trees are objectionable, and can serve as misguided missiles for both children and adults. Additional thornless staminate trees need to be selected; those that have been chosen deserve further testing. The tree seems to be tolerant of adverse conditions, and it may well rival *Ailanthus altissima* in quality of "street and city toughness." *Maclura* is one of the best trees for infertile, clayey, and droughty soils and is tolerant of severe pruning. In the Midwest and Plains states, the species is used for fencerows and windbreaks. It would make a good container plant.



*Magnolia acuminata*

Cucumber Magnolia



HEIGHT: 50-80 feet

SPREAD: 50-80 feet

HABIT: pyramidal in youth, becoming rounded to wide-spreading at maturity

ZONE: 4

ENVIRONMENT: full sun; prefers deep, moist soil; pH adaptable; spring transplant

Cucumber magnolia is a magnificent sight when fully matured; unfortunately, it is large and not well adapted to the rigors of urban conditions. The dark green leaves turn ash-brown in fall. Green to yellow-green flowers develop after the foliage in May and are lost among the leaves. The rose-red, elongated, cucumber-like fruits mature in September. In winter the ash-brown bark develops a slight scaly character and is quite attractive. The fleshy nature of the root system precludes ease of transplanting and establishment. Under stress the species often develops water sprouts that ruin its appearance. It also may exhibit leaf burn in dry, compacted soils. This is a splendid tree for parks and large areas where root space is not restricted.

### ***Magnolia heptapeta***

(*M. denudata*)

### **Yulan Magnolia**



HEIGHT: 20-35 feet

SPREAD: 15-25 feet

HABIT: pyramidal in youth, becoming more rounded with age

ZONE: 5

ENVIRONMENT: full sun; well-drained, acid soil; spring transplant



This species has abundant, large, pure white, cup-shaped flowers in April and honey-brown foliage in autumn. These characteristics, along with its strong structure, ease of culture, and smooth gray bark combine to make it a first choice among magnolias. Yulan magnolia is represented in the Boston area by several large specimens growing along Commonwealth Avenue near the Public Garden. Its disadvantage is that the flowers appear early and are often browned by freezing temperatures. In addition, it seems to be a species almost totally neglected in the nursery trade for, compared to *Magnolia* × *soulangiana* and *M. stellata*, it is difficult to propagate from cuttings. As with all magnolias, spring transplanting with a ball of earth is recommended because of the fleshy root system.

### *Morus alba*

### Common Mulberry



HEIGHT: 30-50 feet

SPREAD: 30-50 feet

HABIT: rounded, dense, usually low-branched with a thick canopy

ZONE: 4

ENVIRONMENT: sun; withstands drought, urban and seaside conditions; pH adaptable

The "alley-cat" nature of this species makes it a perfect tree for city conditions. Its principal assets include adaptability, fast growth, and pest-free foliage; liabilities are the weediness, the fruit, and the tremendous variation in seed-grown plants. Witches-broom may be a problem on certain plants. This species tends to be late leafing. 'Kingan' and 'Stribling' are fruitless, fast-growing clones with glossy summer foliage but may be less hardy than the species. 'Stribling' develops outstanding yellow fall color. The species is a good choice for compacted, dry soils where few plants will grow. Fruit is edible and birds find it irresistible — a fact that leads to wide dispersal of weed seedlings.

### *Nyssa sylvatica*

### Sour Gum, Black Tupelo





HEIGHT: 40-60 feet

SPREAD: 20-40 feet

HABIT: pyramidal in youth, becoming pyramidal-rounded at maturity

ZONE: 4

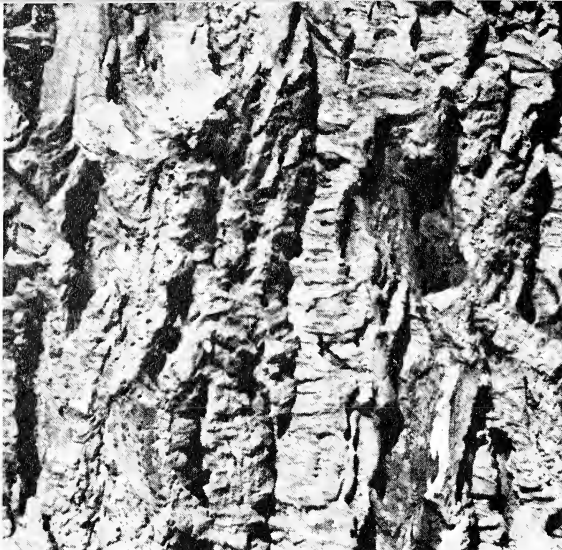
ENVIRONMENT: full sun; prefers acid, moist soils but is found in swamps and upland well-drained soils in the wild

Sour gum is one of the most beautiful native trees, but is limited in commerce. It is difficult to transplant, and this has restricted its wholesale use. The lustrous, dark green foliage is transformed into almost fluorescent yellow, red, and purple fall tones, making it a superior tree for fall color. It is reasonably pest free; however, scale and fall webworm have been reported. The species shows good tolerance to aerial salts. Container-grown plants may prove to be easiest to transplant. The habit of many specimens is reminiscent of that of pin oak (*Quercus palustris*). Sour gum makes an excellent lawn or park tree and is a good choice for wet areas. In Michigan it has been used in parking lot islands with success.

### *Phellodendron amurense*

### Amur Corktree





HEIGHT: 30-40 feet

SPREAD: 30-40 feet

HABIT: usually broad-spreading,  
with a short trunk and an open,  
rounded crown of large horizontal  
to ascending branches

ZONE: 4

ENVIRONMENT: full sun; adaptable  
to extremes of soil and pH; tolerates  
air pollutants: extremely tolerant of  
city conditions

Not a graceful tree in youth and often shunned because of this, Amur cork-tree develops picturesque branches and corky bark with age. The pest-free, dark green foliage becomes clear yellow in fall and drops soon after coloring. This is one of the first trees to completely defoliate in the autumn. The black fruits are borne in grape-like clusters on pistillate trees and will stain sidewalks upon abscissing. The bark is attractive to vandals and the low-slung branches make it a popular climbing tree. The plant is slow to recover after transplanting. It is best used in parks or other large, open areas.

### *Prunus serrulata* 'Kwanzan'

### Kwanzan Cherry





**HEIGHT:** 20-25 feet  
**SPREAD:** 20-25 feet  
**HABIT:** usually grafted on a standard and forms a vase-shaped tree

**ZONE:** 5  
**ENVIRONMENT:** full sun; adaptable but prefers moist, well-drained soil; spring transplant

This cultivar is one of the more popular and hardy forms of *Prunus serrulata*. The new foliage is bronze and changes to lustrous, dark green. Fall foliage may be a good bronze. The deep pink, 2½-inch-diameter, double flowers develop with the expanding leaves in May. Like most cherries, it is not long-lived and would not be a good choice for poor soils and heavily polluted areas. It has been used as a boulevard tree along suburban streets and as a park tree. The authors have observed trees that were not grafted and these appeared much more aesthetically pleasing. They formed low-branched, multistemmed, wide-spreading crowns and the gray-brown, prominently lenticelled bark added winter interest. Cherries should always be used in low-stress situations.

## *Quercus acutissima*

## Sawtooth Oak



**HEIGHT:** 35-45 feet  
**SPREAD:** variable  
**HABIT:** pyramidal in youth becoming more oval-rounded with age

**ZONE:** 6 (5)  
**ENVIRONMENT:** full sun; moist, acid, well-drained soil

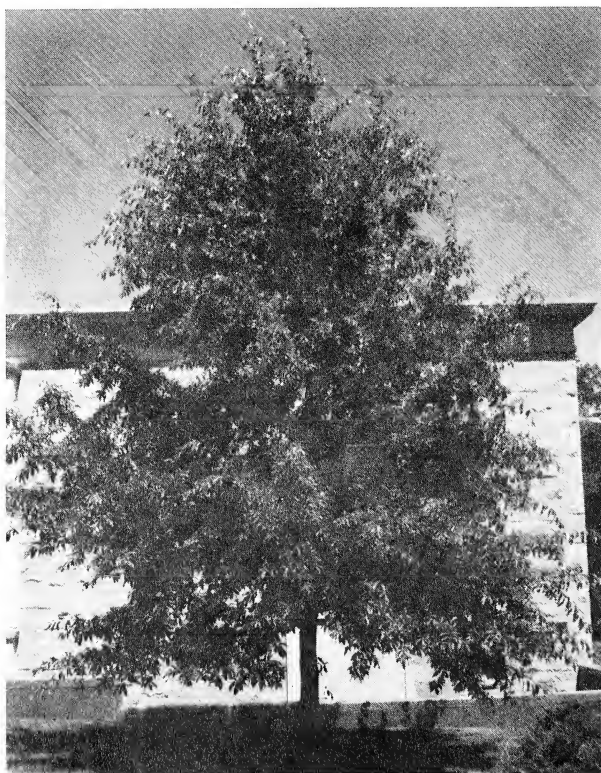




A slow-growing oak with relatively dense habit and lustrous green foliage that holds late, this species has apparent freedom from insects and diseases. Its hardiness is suspect, and damage has occurred when temperatures reach  $-20^{\circ}\text{F}$ . Chlorosis may appear on plants grown in high pH soils. Nonetheless, it is a worthwhile alternative to *Quercus palustris* and *Q. rubra*. The fall color is poor and the brown leaves persist through winter. It is easy to transplant. The authors have seen vigorous specimens from Boston, Massachusetts to Athens, Georgia, and west to Illinois.

### *Quercus imbricaria*

### Shingle Oak



HEIGHT: 40-60 feet  
 SPREAD: 40-60 feet  
 HABIT: pyramidal with age; rounded  
 with drooping lower lateral branches

ZONE: 4  
 ENVIRONMENT: full sun; moist, well-  
 drained soil

Symmetrical in form, this species has simple, unlobed, dark green summer foliage and brown to russet autumn color. Transplanting is easier than with most oaks; the growth is slow and the leaves persist into winter. The tree tolerates pruning, and it even has been used as a hedge. The leaves often hold late into spring and provide some winter interest. Leaf spot can be troublesome in wet weather. It makes a good park or large area tree and has been used along suburban streets in several Midwestern cities.

### *Quercus nigra*

### Water Oak

HEIGHT: 50-80 feet  
 SPREAD: variable, usually less than  
 height  
 HABIT: pyramidal to round-  
 topped

ZONE: 6  
 ENVIRONMENT: full sun; moist sites  
 are preferred

A popular species in the Southern states where it occurs naturally in the bottom-land along streams, *Quercus nigra* has been extensively used for landscaping since it transplants readily. The lustrous, dark green foliage holds quite late, and green leaves have persisted even into December on trees in Cincinnati, Ohio. Its native range extends from southern New Jersey to southeastern Missouri, and to Florida and Texas. It should not be grown far north of this because of its lack of hardiness.

### *Robinia pseudoacacia*

### Black Locust





**HEIGHT:** 30-50 feet

**SPREAD:** 20-35 feet

**HABIT:** ranges from an upright tree with a strong trunk and a narrow, oblong crown to a suckering, colonizing shrub

**ZONE:** 4 (3)

**ENVIRONMENT:** full sun; will grow in any soil except those that are permanently wet; pH adaptable; tolerates salinity



Although tolerant of many stresses, black locust tends to be weedy and extremely susceptible to borer and mimosa webworms, which can riddle entire plantings. It has bluish-green foliage and white, fragrant, pendulous flowers in May and June. A prolific seeder, even two- to three-year-old trees often produce abundant fruit crops. *Robinia pseudoacacia* will tolerate the most infertile soils, as well as the heaviest clays. It has been used extensively in the Midwest and East to stabilize cuts and fills along freeways. It has the ability to fix atmospheric nitrogen. A good plant for strip mines, poor soils, and saline conditions, it is one of the more predominant trees on Cape Cod because of its tolerance to aerial salt spray. Black locust is best used in multiple-plant clusters rather than as a specimen tree.

*Sassafras albidum***Sassafras**

HEIGHT: 20-50 feet

SPREAD: 20-35 feet

HABIT: pyramidal to irregular and tree-like in its best form; often sucker-ing and forming extensive clumps

ZONE: 4

ENVIRONMENT: full sun; moist to dry, acid, well-drained soils; very adaptable species

*Sassafras* is a pioneer species that invades abandoned fields and road cuts. Three leaf shapes can occur on each plant: ovate, mitten-shaped, and three-lobed. In autumn, the coloration is yellow, orange or scarlet. The yellow flowers that appear before the leaves give rise to bluish fruits borne on scarlet pedicels. The rich brown mature bark is thick and deeply ridged and, along with the bright green winter twigs, is ornamental in the winter landscape. *Sassafras* is tolerant of poor, dry soil. The stems, leaves, and roots are aromatic when crushed. Limitations to the use of *Sassafras* include infestations of Japanese beetles, transplant difficulties, and intolerance of compaction and high pH soils. Successful transplanting of plants moved from the wild averages only 10 percent. Selections for good habit need to be made and these must be propagated vegetatively. Container growing, at least in small sizes, offers an alternative method of facilitating successful transplanting.

*Sorbus alnifolia*

**Korean Mountain-ash**



HEIGHT: 30-50 feet

SPREAD: 20-40 feet

HABIT: pyramidal in youth, ranging from pyramidal-oval to rounded at maturity

ZONE: 4

ENVIRONMENT: full sun; well-drained, moist soils, adaptable to varied soil conditions; pH adaptable



The handsomest of the mountain-ashes, *Sorbus alnifolia* does not resemble a typical species in its leaf characteristics. Rich green, summer foliage turns golden-yellow in fall. White flowers (May) are followed by loose clusters of red fruits which persist into winter. Smooth, gray, beech-like bark adds seasonal interest to this four-season ornamental that never fails to satisfy. Fire blight is a problem but this species exhibits better borer resistance than does *S. aucuparia*. It tends to branch low and would have to be headed-up for street tree use. Korean mountain-ash tends to be alternate in flowering and fruiting. Landscape planners should be recommending this species over the inferior *S. aucuparia*.

### *Syringa reticulata*

(*S. amurensis* var. *japonica*)

### Japanese Tree Lilac



HEIGHT: 20-30 feet

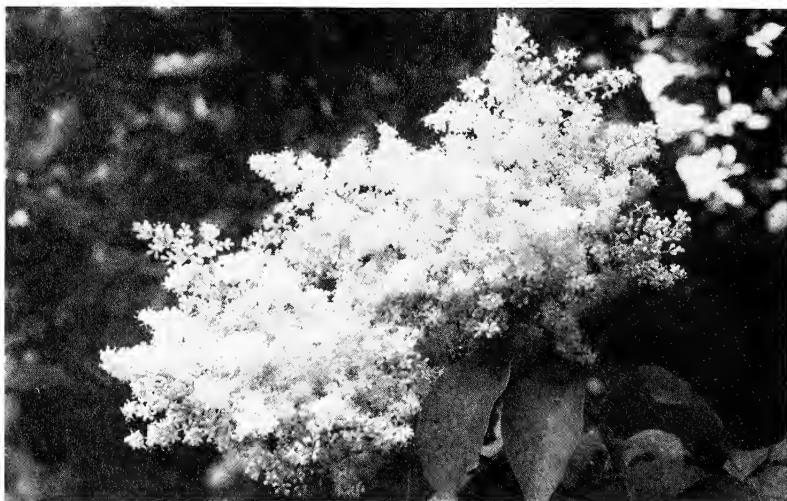
SPREAD: 15-25 feet

HABIT: large shrub or small tree  
developing an oval to rounded crown

ZONE: 4

ENVIRONMENT: full sun; moist, well-  
drained soil; pH adaptable





This species has been overlooked for general landscape use, but from the standpoint of adaptability and pest resistance is superior to other lilacs. The dark green foliage does not contract mildew, which is common to *Syringa vulgaris* and *S. × persica*, and the tree is quite resistant to borers. The reddish-brown to brown bark is prominently marked with horizontal lenticels that give it a “cherry-like” effect. The white, fragrant (privet-like) flowers are borne in large panicles during June. This species has been used in suburban areas. Seed-grown trees show considerable variation in habit. The species is easily propagated from summer softwood cuttings.

### ***Taxodium distichum***

### **Common Baldcypress**





HEIGHT: 50-70 feet  
 SPREAD: 20-30 feet  
 HABIT: deciduous conifer of slender, pyramidal habit when young, becoming more open and wide-spreading at maturity

ZONE: 4  
 ENVIRONMENT: full sun; grows best in well-drained, moist, acid situations

A valuable tree for wet, swampy areas, yet also adaptable to dry situations, common baldcypress has been used successfully in Illinois and Maryland as a street tree. The rich green summer foliage becomes russet or soft reddish-brown in fall; the orange- to reddish-brown bark is handsome during the winter months. This species' adaptability to wet and dry soils promotes its use in areas where other trees would fail. Chlorosis is troublesome in soils of high pH, and a gall-forming insect often creates unsightly growths on the tips of branches. In some locations, the tree also is affected by a tip borer.

### *Ulmus carpinifolia* 'Christine Buisman'      Christine Buisman Elm

HEIGHT: 50-60 feet  
 SPREAD: 20-35 feet  
 HABIT: broadly pyramidal, somewhat irregular

ZONE: 4  
 ENVIRONMENT: full sun; sandy to clay soil; tolerant of heat, drought, compacted soil, and cold; pH adaptable

This plant has no outstanding ornamental characteristics, however it continues to be offered because it is quite resistant to Dutch elm disease. The dark green foliage does not color well in fall. This cultivar grows rapidly, transplants easily, and is tolerant of both atmospheric pollution and extremely difficult growing situations. The major disadvantage is susceptibility to Japanese beetles. The plant has a place but only where more ornamental species will not thrive. Two *Ulmus* × *hollandica* cultivars with a similar appearance to it also display Dutch elm disease resistance: they include 'Commelin', rapid-growing and small-leaved, and 'Groenveldt', medium-growing and upright.



## TRIAL LIST

A handful of trees have proven outstanding under street conditions, and this has contributed to their extensive use to the exclusion of many others that, if tested, might prove equally functional. The major reason for trying new trees is to expand the genetic composition represented along our city and suburban streets and, over the long term, to build greater population stability to resist devastation through insect, disease, or abiotic factors. If those towns and cities where every street was planted with American elm (*Ulmus americana*) had practiced diversification, the ruination of the landscape would not have been so devastating.

Many municipalities now have tree ordinances that specify that a single species, including all cultivars, may not constitute more than 10 percent of the total tree population. Unfortunately, most landscape planners work from a favorite list and do not make use of the wide diversity available.

The trees on the trial list that follows have proven to be good performers in the Arnold Arboretum or in other gardens across North America. For the most part, they all have been maintained under reasonable growing conditions and not under the stresses encountered along urban streets. Only long-term trial under a variety of growing conditions will provide adequate data relative to their performance on city streets.

A major problem will be finding adequate sources of supply, for many of these trees are currently represented only in arboreta or botanical gardens. A few of these species are available commercially in limited quantities and small sizes, but most will need to be custom propagated and grown on before planting. As a result, an innovative spirit among nurserymen and landscape planners is needed.

The Arnold Arboretum, and perhaps other public gardens, will supply cuttings, scions or seeds to any nurseryman, arborist, or street tree commission who wishes to test these trees but *cannot locate a commercial source*. To obtain test material from the Arnold Arboretum write:

Street Tree Trials  
The Arnold Arboretum of Harvard University  
The Arborway  
Jamaica Plain, MA 02130

*Acer cappadocicum*

## Coliseum Maple



HEIGHT: 40-60 feet  
 SPREAD: 20-30 feet  
 HABIT: upright-oval

ZONE: 5  
 ENVIRONMENT: full sun to light  
 shade; well-drained soil; pH adaptable

This maple has proven itself as a street tree in several cities in the Pacific Northwest. Summer foliage is dark green changing to yellow in the autumn. The cultivar 'Rubrum' is unusual because the young leaves emerge red before turning green. This maple is pest free, and easy to transplant. The canopy is light-headed and the root system sufficiently deep so that solid grass cover can be maintained easily.

***Acer velutinum*****Persian Maple**

HEIGHT: 70-90 feet  
 SPREAD: 50-70 feet  
 HABIT: rounded

ZONE: 6 (5?)  
 ENVIRONMENT: full sun; well-drained soil

Persian maple has proven itself to be tough and adaptable as an avenue tree in Victory Park, Tbilisi, U.S.S.R. Its leaves resemble those of *Acer pseudoplatanus*, sycamore maple, for they are large, thick, and dark green in the summer landscape, with little or no autumn color. Yellowish-green flowers in upright panicles are ornamental. This maple is a rapid grower, easy to transplant and appears to be free of insect and disease pests. It is recommended here in an attempt to broaden the genetic diversity of the genus *Acer* in North America. Availability will limit use.

***Alnus cordata*****Italian Alder**

HEIGHT: 30-50 feet  
 SPREAD: 20-30 feet  
 HABIT: softly pyramidal in youth  
 and old age

ZONE: 5  
 ENVIRONMENT: full sun; thrives in poor, dry soil but prefers moist (wet) situations; tolerates acid or alkaline soils; withstands compaction



*Alnus cordata* is undoubtedly one of the handsomest of the alders. Its glistening medium to dark green leaves persist into fall and do not appear as coarse as the leaves of *A. glutinosa*. The rich, dark brown, cone-shaped fruits are the largest of those on species in cultivation. This is a splendid lawn tree that would make a fine urban tree as well, though it has not been tried to any degree. Italian alder grows rapidly and, along with *A. glutinosa*, is quite tolerant of high pH soils. The use of *A. glutinosa* along interstate highways has prompted the authors to suggest *A. cordata* as an alternative because of its superior ornamental characteristics.

### *Alnus glutinosa*

### European Alder



**HEIGHT:** 40-60 feet

**SPREAD:** 20-40 feet

**HABIT:** weak pyramidal outline; may develop ovoid or oblong head of irregular proportions

**ZONE:** 3

**ENVIRONMENT:** full sun or light shade; wet or dry, acid or alkaline soil; extremely adaptable

*Alnus glutinosa* 'Fastigiata'



One of the best trees for extremes of soil and climate, the common alder currently is used by highway departments along interstate highways and freeways. It will survive sites with standing water, where it will seed naturally and develop thickets; but it makes its best growth in well-drained, evenly moist soils. Its adaptability to dry soils is an asset. Lustrous, dark green foliage holds late into fall. *Alnus glutinosa* may suffer from leaf miner, tent caterpillar and stem cankers, and the wood is somewhat weak. This species and *A. cordata* are able to fix atmospheric nitrogen which allows them to survive in low-fertility soils. The former is worth considering for areas where few other trees will grow. 'Pyramidalis' ('Fastigiata') is an upright form that resembles Lombardy poplar in outline but is slower growing. This species is useful only where more ornamental trees may not thrive.

### ***Betula nigra***

### **River Birch**





HEIGHT: 40-70 feet

SPREAD: 40-60 feet

HABIT: gracefully pyramidal to oval-headed in youth; often rounded at maturity

ZONE: 4

ENVIRONMENT: full sun; acid, moist soil; will develop iron chlorosis in high pH soils; transplant in spring

The most widely distributed American birch, *Betula nigra* ranges from Minnesota to Florida, and Massachusetts to Kansas. In the Arnold Arboretum, it is one of the tallest birches. It consistently outperforms the white-barked species in warmer climates. The medium green, summer foliage is lustrous, but fall color is a poor yellow-green. Leaves tend to spot in wet weather. The bark exfoliates in papery sheets, exposing the inner bark which can exhibit color combinations of gray-, cinnamon- and reddish-brown. River birch is resistant to the bronze birch borer and is quite tolerant of wet soils, for it occurs in the wild along stream banks and swampy bottomlands that are periodically flooded. Tests conducted at the shade tree plots of the Ohio State University in Wooster, Ohio, indicate that this tree grows 2-3 feet per season. River birch is probably a better choice for urban situations than white-barked species but is still subject to having its bark stripped by vandals.

### *Carpinus tschonoskii*

### Yeddo Hornbeam





HEIGHT: 30-40 feet

SPREAD: 25-35 feet

HABIT: upright pyramidal, becoming  
rounded with age

ZONE: 5?

ENVIRONMENT: full sun; well-  
drained soil

Yeddo hornbeam is recommended in order to widen the array of useful plants in the genus *Carpinus*. It features medium green, summer foliage turning yellowish-brown in the autumn. The tree is a slow grower but once established is durable and dependable. Transplanting may present some difficulties for it is slow to re-establish itself. This plant appears to be pest free, structurally strong, and culturally adaptable.

### *Catalpa ovata*

### Chinese Catalpa



*Catalpa speciosa*

HEIGHT: 25-35 feet

SPREAD: 15-25 feet

HABIT: pyramidal to spreading

ZONE: 5

ENVIRONMENT: full sun; well-drain-  
ed soil; pH adaptable



Fruits of *C. speciosa*

The common and western catalpa (*Catalpa bignonioides* and *C. speciosa*) found their way into highway landscapes earlier this century but have fallen into disfavor because of their large, coarse foliage and litter from flowers, leaves, and fruits. Despite these drawbacks, they remain adaptable ornamental trees. *C. ovata* is similar to *C. bignonioides* except that it is smaller in stature and has smaller leaves, flowers, and fruits. During June, erect pyramidal panicles of yellowish-white flowers adorn the tree. They are followed by slender, 8-12 (-18)-inch-long greenish capsules. Chinese catalpa is extremely easy to grow from seed; one year seedlings are known to have flowered and fruited. Availability will limit use.

### *Celtis jessoensis*

### Jesso Hackberry



HEIGHT: 30-50 feet  
 SPREAD: 20-40 feet  
 HABIT: upright spreading; branches  
 high

ZONE: 5  
 ENVIRONMENT: full sun; well-  
 drained soil; like most hackberries,  
 well-adapted to extremes of climate  
 and soil

Common hackberry (*Celtis occidentalis*) is a tough, durable and adaptable plant for difficult urban landscapes, but its use has been discouraged because of unattractive witches-brooms and leaf galls. From our observations and on the basis of limited trials, *C. jessoensis* appears to be free of both problems. The semilustrous, rich green leaves are free of the nipple gall and mottling that are prevalent on *C. occidentalis*. In addition, it develops strong crotch angles, an upright branching habit, and smooth gray bark. It appears to have the characteristics of a good street tree. Summer foliage is rich green changing to pale yellow in the autumn. Availability will limit use. This Asiatic species is the most ornamental of the hackberries in the Arnold Arboretum's collections. Recent laboratory hardiness determinations at the University of Minnesota have shown it to be cold-hardy to at least  $-16^{\circ}\text{F}$ .

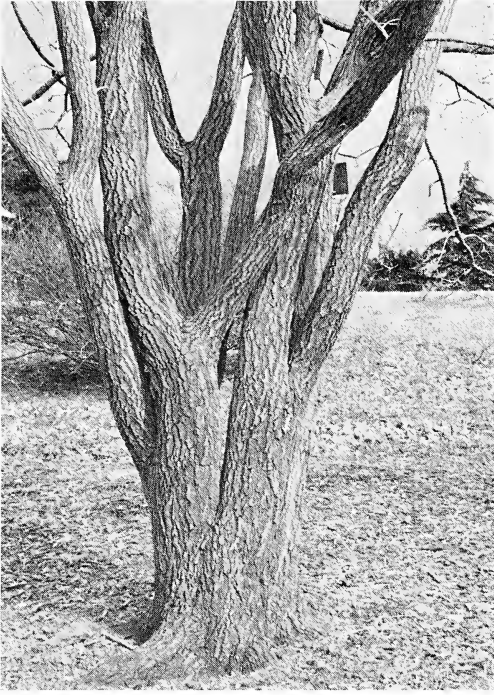
### *Chionanthus retusus*

### Chinese Fringetree



HEIGHT: 15-25 feet  
 SPREAD: 15-25 feet  
 HABIT: small low-branched tree or  
 large shrub of rounded outline

ZONE: 6  
 ENVIRONMENT: full sun; moist, well-  
 drained, acid soil



Most gardeners are familiar with *Chionanthus virginicus*, our native fringetree, but know nothing of the Chinese species. The Arnold Arboretum has several accessions and some are shrubby and weak-growing, while the most notable is a small tree with singularly beautiful branch structure, bark, and flowers. The dark green foliage does not develop good fall color. The snow-white flowers are produced in terminal panicles during late May and June. Flowering is heavy in alternate years. Dark blue fruits develop only on pistillate plants. Little is known about pollution tolerance but the species certainly deserves testing in this regard. Slow growth may limit use but *C. retusus* merits a place in special landscape plantings. It is more easily rooted from softwood cuttings than its American relative, and superior forms could be perpetuated.

### *Cornus alternifolia*

**HEIGHT:** 15-25 feet  
**SPREAD:** variable, but often wider than high  
**HABIT:** low-branched small tree or large shrub with horizontal branching pattern

### Pagoda Dogwood

**ZONE:** 3  
**ENVIRONMENT:** light shade; moist to dry, acid soil; excessive heat may cause decline

This is a beautiful native species that appears almost weedlike in the Smoky Mountains. The authors have observed it growing in dense shade in moist, alluvial soils. The medium to dark green summer foliage is followed by soft reddish-purple fall color which, unfortunately, is not consistent. The leaves are arranged in an alternative fashion, differentiating the species from most dogwoods. White flowers are borne above the foliage in May/June and yield purplish-black fruits on rose-red stalks in July/August. It is much more dependable than *Cornus florida* for flowers. Winter stem color is a lustrous brown to purple, and large trunks develop an interesting, interlacing, ridged-and-furrowed pattern of soft gray. As the plant matures, the branches become horizontally disposed. The species is susceptible to twig canker which may limit landscape use, but vigorous plants are not as susceptible. When used in above-ground containers, *C. alternifolia* makes a superlative plant. It has much to offer, as do *C. controversa* and *C. macrophylla*, but needs some shade for best growth. Use where space permits the low, spreading, branching habit.

### *Cornus controversa*

### Giant Dogwood



HEIGHT: 20-40 feet

SPREAD: 15-30 feet

HABIT: pyramidal, becoming flat-topped and horizontally branched

ZONE: 5

ENVIRONMENT: full sun to light shade; well-drained soil



On this species, tiers of horizontal branches bear an abundance of creamy-white flowers in terminal clusters during May. In autumn the plant has black fruit and foliage colors of bronze to red. Branchlets are gray with longitudinal fissures. *Cornus controversa* needs to be evaluated for resistance to drought stress and to salts found along highways. It is susceptible to twig canker, but vigorous specimens exhibit good resistance. In vegetative and reproductive characteristics, this species is similar to *C. alternifolia*. Laboratory cold-hardiness tests indicated stem hardiness to at least  $-38^{\circ}\text{F}$ , which means *C. controversa* could be grown at least another zone north of the range described by Rehder in *Manual of Cultivated Trees and Shrubs*.

### ***Cornus macrophylla***

### **Largeleaf Dogwood**

HEIGHT: 20-40 feet  
 SPREAD: 15-30 feet  
 HABIT: pyramidal to rounded

ZONE: 5  
 ENVIRONMENT: full sun to light shade; well-drained, acid or alkaline soil

Summer flowering trees are often neglected in favor of spectacular spring performers. This deciduous tree bears large flat clusters of creamy-white flowers in July, followed by blue-black fruits. The birds quickly consume the fruit but the stalks turn rose-pink and are ornamental for two to three weeks in autumn. Leaves hold late into the fall and were still green in mid-November, 1978. This species can be easily rooted from cuttings. In laboratory tests, the stems proved hardy to  $-22^{\circ}\text{F}$ .

***Corylus colurna***

**Turkish Filbert or Hazel**



**HEIGHT:** 40-50 feet

**SPREAD:** 20-30 feet

**HABIT:** pyramidal with very uniform  
branch structure

**ZONE:** 4

**ENVIRONMENT:** full sun; thrives in  
hot summers and cold winters; with-  
stands drought; pH adaptable





The mention of *Corylus colurna* strikes fear into the hearts of landscape architects, nurserymen, and teachers of plant materials because most have never heard of it. The authors cannot remember ever seeing a disheveled specimen, but admittedly all specimens they have seen were housed in arboreta, botanic gardens, campuses or cemeteries. The dark green summer foliage holds late and may turn a yellow-green in fall. The gray-brown bark develops a scaly characteristic, and as the scales fall, a rich orange-brown inner bark is exposed. Branches are widely spaced, arise from U-shaped angles, and appear to have great structural strength. The fruits are quite large and create some litter, though squirrels are fond of the nuts and effectively remove many of them. Although not enough is known of its urban tolerance, *C. colurna* should be more widely tried in cities, possibly as a containerized tree. It reportedly is doing well in the Minneapolis, Minnesota area where winter lows may reach  $-30^{\circ}\text{F}$ .

***Crataegus laevigata* 'Superba'**  
(also listed as *C. l.* 'Crimson Cloud')

**Crimson Cloud Hawthorn**

HEIGHT: 15-20 feet

ZONE: 4

SPREAD: 10-15 feet

ENVIRONMENT: full sun; tolerant of  
sandy or clayey soils; pH adaptable

HABIT: pyramidal to rounded

Reports coming into the Arnold Arboretum are mixed about this plant. Some consider it valuable, while others report minimal success. Its landscape attributes include single bright red flowers with a white star-shaped center (May) and persistent red fruits. Its limitations include susceptibility to fire blight, cedar hawthorn rust and lace-bug; however, it is resistant to the leaf spot that is so troublesome on *C. laevigata* 'Paulii'.

***Crataegus punctata* 'Ohio Pioneer'**

**Ohio Pioneer Dotted Hawthorn**

HEIGHT: 20-30 feet

ZONE: 4

SPREAD: 20-30 feet

ENVIRONMENT: full sun; heavy clay  
to well-drained soil; pH adaptable

HABIT: rounded; densely foliated

This is a new cultivar that may prove outstanding with time. The authors have seen the parent tree and were impressed with the abundant white flowers (May) and the clean foliage. The fruits are red and quite large, and the stems exhibit a silver-gray color. Fire blight has not appeared to be a problem and the plant seems resistant to rust. The cultivar is essentially thornless, which will permit use in high traffic areas. Like most hawthorns, it is well adapted to dry, compacted soils and would make a good street or container plant.

***Eucommia ulmoides***

**Hardy Rubber Tree**



HEIGHT: 40-60 feet  
SPREAD: 50-70 feet  
HABIT: rounded to spreading,  
usually densely branched

ZONE: 5  
ENVIRONMENT: full sun; moist or  
dry soils; pH adaptable

Successful street plantings in Cleveland, Ohio, and Indianapolis, Indiana, demonstrate that this tree warrants greater trial. *Eucommia* performs well in a variety of climates and soils, shows good heat, drought and cold tolerance, and has no serious insect or disease pests. The lustrous, dark green foliage holds late. Variable in habit when seed-grown, it is often wide-spreading and low-branched. Trees must be headed-up for street tree use. The species is worth trying in difficult, compacted sites, and probably is best suited for parks or spacious areas because of its wide crown.

*Fraxinus excelsior* 'Hessei'

## Hesse European Ash



HEIGHT: 50-60 feet

SPREAD: 30-50 feet

HABIT: upright-oval in youth, at  
maturity rounded

ZONE: 5

ENVIRONMENT: full sun; moist to  
dry soils; pH adaptable

This is an unusual ash, for the leaf is simple rather than pinnately compound. Leaves are leathery, lustrous, dark green and do not develop fall color. The tree is fast growing and forms a uniform head in a short time. Like all European ash cultivars, it may prove susceptible to borer damage but to date has proven quite resistant. At the University of Minnesota Landscape Arboretum ( $-30^{\circ}\text{F}$ ), *Fraxinus excelsior* and the cultivars 'Kimberly Blue', 'Hessei', and 'Aurea' have not proven hardy. Interest in new ash cultivars is always high because the genus shows good resistance to pollutants and poor soil conditions.

*Fraxinus nigra*

## Black Ash

HEIGHT: 30-50 feet

SPREAD: 30-40 feet

HABIT: small to medium-sized,  
sparsely branched tree of pyramidal  
to rounded outline

ZONE: 2

ENVIRONMENT: full sun; dry or wet  
soil; pH adaptable.

Black ash is not well known for street tree use but may have possibilities because of its adaptability to wet, boggy conditions. The dark green summer foliage does not color well in fall. The bark tends toward a flaky or corky characteristic. Occurring naturally in low, swampy ground from Newfoundland to Manitoba, south to Virginia and Arkansas, the species has performed well in the University of Minnesota Landscape Arboretum. The male cultivar, 'Fallgold', which originated at the Canadian Agricultural Research Station, Morden, Manitoba, has disease-free foliage that develops golden fall coloration. *Fraxinus nigra* offers genetic diversity in areas where green ash (*F. pennsylvanica*) is the dominant street tree species.

### *Fraxinus ornus*

### Flowering Ash



HEIGHT: 30-40 feet  
 SPREAD: 20-30 feet  
 HABIT: compact; upright-oval to rounded; rather stiff and coarse

ZONE: 6  
 ENVIRONMENT: full sun; moist, well-drained soils



Seldom seen in American landscapes but long popular in European gardens, this species has showy, fragrant, creamy-white flowers borne in 5- to 6-inch panicles in May. The leaves are dark green and offer no fall color. Based on observations throughout the East and Midwest, the species lacks vigor although a West Coast nursery is now promoting it. Its hardiness is suspect and temperatures lower than  $-10^{\circ}\text{F}$  may induce injury. Borers, scale and canker may limit the tree's landscape effectiveness, especially where urban stresses exist.

*Fraxinus quadrangulata*

**Blue Ash**





HEIGHT: 40-70 feet  
 SPREAD: 20-40 feet and more  
 HABIT: upright-spreading, selected  
 trees are oval-rounded

ZONE: 4  
 ENVIRONMENT: full sun; tolerates  
 both wet and dry, acid or alkaline soil

This species is one of the ashes most tolerant of dry soils, although it does well in moister conditions. The branches are four-angled and winged. The lustrous green summer foliage turns a pale yellow in autumn. The bark is different from that of most ashes since it develops a scaly appearance, rather than the more typical ridged and furrowed diamond patterns. The species has proved to be difficult to propagate and is considerably slower growing than either *Fraxinus americana* or *F. pennsylvanica*. It is hardy in Minnesota ( $-30^{\circ}\text{F}$ ) and deserves further trial.

### *Halesia carolina*

### Carolina Silverbell





HEIGHT: 30-40 feet (70 feet)

SPREAD: 25-35 feet

HABIT: low-branched tree with a comparatively narrow crown; sometimes multiple-stemmed and rounded

ZONE: 4

ENVIRONMENT: full sun or light shade; acid, moist, well-drained soil, but fairly adaptable



*Halesia carolina* is a superior tree from many aspects: attractive foliage and bark; white, bell-shaped flowers in May; and interesting four-winged fruits. Its one drawback is that it is not uniform in habit and for this reason it has been shunned in street and city plantings. Although somewhat slow to establish after transplanting, it is easily rooted from softwood cuttings and maintenance of specific characteristics is relatively simple. *Halesia* exhibits excellent disease and insect resistance. Chlorosis may develop in extremely high pH or compacted soils. Carolina silverbell is best suited to growing in large areas and could be used to advantage in city parks or along large parkways. It has been reported that the species is susceptible to wind-throw, especially after heavy rains which loosen the soil.



***Kalopanax pictus***

**Castor-aralia**



**HEIGHT:** 40-60 feet

**SPREAD:** 40-60 feet

**HABIT:** upright-oval to obovate in youth; assumes a rounded outline with massive, heavy branches in old age

**ZONE:** 4

**ENVIRONMENT:** full sun; deep, rich moist soil; pH adaptable



*Kalopanax pictus* is a large, coarse tree with a tropical appearance. The large, dark green leaves turn yellow (reddish-purple) in the fall. Terminal clusters of small whitish flowers that open in July/August are followed by purple-black fruits in September/October. The blackish bark is deeply ridged and furrowed, and the young stems are covered with prominent spines that persist on older branches. For this reason, castor-aralia may be a worthwhile alternative in high vandalism areas. The species has proved hardy to  $-33^{\circ}\text{F}$  in laboratory tests.

***Metasequoia glyptostroboides***

**Dawn Redwood**



HEIGHT: 60-70 feet (100 feet)  
 SPREAD: 15-25 feet  
 HABIT: pyramidal

ZONE: 5  
 ENVIRONMENT: full sun; dry to  
 moist, well-drained soil; pH adaptable

This species was introduced into cultivation through the diligent efforts of the Arnold Arboretum. The feathery, green summer foliage gives way to colors ranging from salmon- to gold-bronze. The autumn color effect with back lighting is superb. *Metasequoia* grows rapidly; there are reports of 2-4 feet in a single year under favorable conditions. Growth habit is very symmetrical, with a strong central leader. With age, the trunk develops a handsome buttressed or fluted effect at the base. The plant is deciduous, which often causes confusion among those who cannot understand why their "needled evergreen" is losing its foliage. In the Washington, D.C. area, stem canker was first reported and now canker infection has been noted on many established trees around the country. A colony of large trees, in small planting islands, has been used at the World of Chocolate exhibit in Hershey, Penn., where it gives a sense of age to plantings that are only a few years old. *Metasequoia* is ideal for park and street plantings where a quick screen is needed. In New Jersey, it has been successfully used as a street tree when the lower branches were removed. The fastest growth is made in warm climates and Zone 6 conditions south should prove most favorable.

### ***Morus rubra***

### **Red Mulberry**



HEIGHT: 40-70 feet  
 SPREAD: 40-50 feet  
 HABIT: upright, more open and irregular than *M. alba* although extremely variable

ZONE: 5  
 ENVIRONMENT: full sun; prefers a rich, moist soil; pH adaptable

A native mulberry that has not been tried for landscape use, this has leaves, fruit, and an ultimate plant size that are larger than are those of *Morus alba*. Male forms should be selected, for the fruit on pistillate plants may create a litter problem. Birds relish the fruit, which may ultimately contribute to weed seedling problems. *M. rubra* is worthy of trial along freeways and in urban parks that are subject to high visitor impact.

### *Ostrya virginiana*

### American Hophornbeam



HEIGHT: 25-40 feet

SPREAD: 25-40 feet

HABIT: very graceful small tree;  
pyramidal in youth, usually rounded  
in old age

ZONE: 4

ENVIRONMENT: full sun to heavy  
shade; cool, moist, well-drained, acid  
soil

The authors believe this tree has been overlooked for street and city plantings. It has succeeded in suburban areas but no adequate documentation is available concerning its tolerance to heavily polluted conditions. The dark green foliage is pest free and may turn yellow in the fall. The grayish-brown bark develops a slight shaggy character and is quite handsome in winter. In the wild the species is often found on gravelly, rocky, rather dry soils. *Ostrya virginiana* is somewhat slow to re-establish after transplanting but if handled in small sizes and moved in spring, it should succeed admirably. The species has been used successfully as a street tree in New Jersey. Since plants are all seed-grown, variation in habit must be expected.

*Pistacia chinensis*

## Chinese Pistache



*Pistacia chinensis* photographed near Tung River, China, in 1908 by E. H. Wilson.

HEIGHT: 40-60 feet

SPREAD: 30-50 feet

HABIT: upright to irregular

ZONE: 6

ENVIRONMENT: full sun; well-drained, acid or alkaline soil; drought tolerant

This is a deciduous tree noted for its glossy, pinnately compound foliage that turns rich shades of orange to reddish-purple in autumn. Terminal clusters of red fruit give ornament to pistillate trees. The light, airy foliage canopy allows the passage of filtered light as does *Gleditsia triacanthos*, and the tree underplants well because of the deep root system. It is an ideal plant for courtyards and mass plantings. Young trees require staking and corrective pruning to establish good form and branch structure. Chinese pistache is a strong-wooded tree with excellent disease and insect resistance. The hardiness range of the species has never been fully explored.

*Populus tremula* 'Erecta'

## Upright European Aspen



HEIGHT: 30-50 feet

SPREAD: 8-10 feet

HABIT: columnar; similar to Lombardy poplar

ZONE: 2

ENVIRONMENT: full sun; adaptable to different soil types

This cultivar is a narrow, fastigate clone which was found in the forests of Sweden. Its foliage and habit are somewhat similar to that of *Populus nigra* 'Italica', Lombardy poplar. While not as fast growing, 'Erecta' is resistant to the canker that afflicts the Lombardy poplar. In wet seasons, however, 'Erecta' may contract a leaf disease that partially defoliates the tree. It is adaptable to cold climates and is performing admirably in Minnesota ( $-30^{\circ}\text{F}$ ). It is perfect for narrow spaces and for creating visual barriers. This European aspen propagates easily from root cuttings.



***Prunus cyclamina***

HEIGHT: 15-25 feet  
 SPREAD: 15-25 feet  
 HABIT: spreading, low-branched,  
 eventually broad rounded in outline

ZONE: 4  
 ENVIRONMENT: full sun; well-  
 drained soil

This rare Chinese cherry species continues to thrive at the Arnold Arboretum even when others have declined because of virus or nematodes. It is a deciduous tree that bears single, delicate pink flowers in early to mid-April. The flower color is highlighted by the bronze color of the new foliage. Rain and wind cause the flowers to shatter quickly. The plant is structurally strong and appears to have a vigor and durability similar to *Prunus sargentii* or *P. × yedoensis*. Laboratory tests have shown it to be hardy to  $-33^{\circ}\text{F}$ .

***Prunus* 'Okame'****Okame Cherry**

HEIGHT: 15-20 feet  
 SPREAD: 10-15 feet  
 HABIT: pyramidal in youth; upright-  
 oval when mature

ZONE: 5  
 ENVIRONMENT: full sun; well-  
 drained soil



This deciduous tree flowers in early April, bearing single pink flowers. Observations at the Morris Arboretum indicate that flowers are preceded by dark maroon buds and after the petals drop, the red calyx (flower base) and stamens persist for another week. The flowering effect is remarkably durable, generally lasting two to three weeks. The small, finely-textured leaves turn bronze in autumn. Because of its compact size, this tree is perfect for areas with restricted head space, such as under low utility wires. It is useful as a specimen, massed, or grown in staggered rows to create a hedgelike effect.

### *Prunus padus*

### European Birdcherry

HEIGHT: 30-40 feet

ZONE: 3

SPREAD: 30-40 feet

ENVIRONMENT: full sun; average,

HABIT: rounded, low-branched,  
dense

well-drained soil; pH adaptable

Cherries are not long-lived trees but this species tends to show good vigor and adaptability. It is one of the first trees to leaf out and the handsome white flowers appear in April and May. It suffers, however, from typical cherry maladies and black knot disease limits its widescale use. For groups or masses along interstate highways it might have merit.



***Pterocarya fraxinifolia***

**Caucasian Wingnut**



HEIGHT: 30-60 feet  
SPREAD: 30-60 feet  
HABIT: rounded to wide-spreading;  
tends to branch low

ZONE: 5  
ENVIRONMENT: full sun; moist, well-  
drained soil; pH adaptable

This tree has been used successfully in Seattle, Washington, and widely in Vienna, Austria, as a street tree. It becomes large with a massive stem and a wide-spreading crown. The leaves are dark green, pinnately compound, and show no propensity to develop good fall color. The winged fruits are borne in pendent clusters 12-20 inches long. The fruit structures are ornamental but pose a litter problem in autumn. The wood tends to be brittle with occasional breakage from storms. The tree should be grown where it has space to develop its full canopy. Additional species that deserve trial include *Pterocarya rhoifolia*, *P. stenoptera* and *P. × rehderana*. Absolute hardiness is suspect, and laboratory tests with *P. × rehderana* have shown it to be hardy to  $-11^{\circ}\text{F}$ . These authors have observed large trees in the Vineland Agricultural Experiment Station, Ontario, Canada and Cave Hill Cemetery, Louisville, Kentucky.

### *Quercus cerris*

### Turkey Oak

HEIGHT: 50-80 feet

ZONE: 6

SPREAD: 40-70 feet

ENVIRONMENT: full sun; well-

HABIT: pyramidal in youth; rounded with age

drained soil; pH adaptable

This is one of the most rapid-growing oaks, with young, established trees sometimes averaging 2-3 feet of growth in a year. Summer foliage is dark green and the autumn foliage is brown. On young trees the leaves may be retained into early spring; this causes problems in thin-stemmed specimens, for the ice and snow loads from winter storms may cause the trees to bend and break. The species is somewhat difficult to transplant.

### *Quercus shumardii*

### Shumard Oak



HEIGHT: 50-70 feet

SPREAD: 50-70 feet

HABIT: large tree reminiscent of pin oak (*Q. palustris*) but does not have the drooping branches

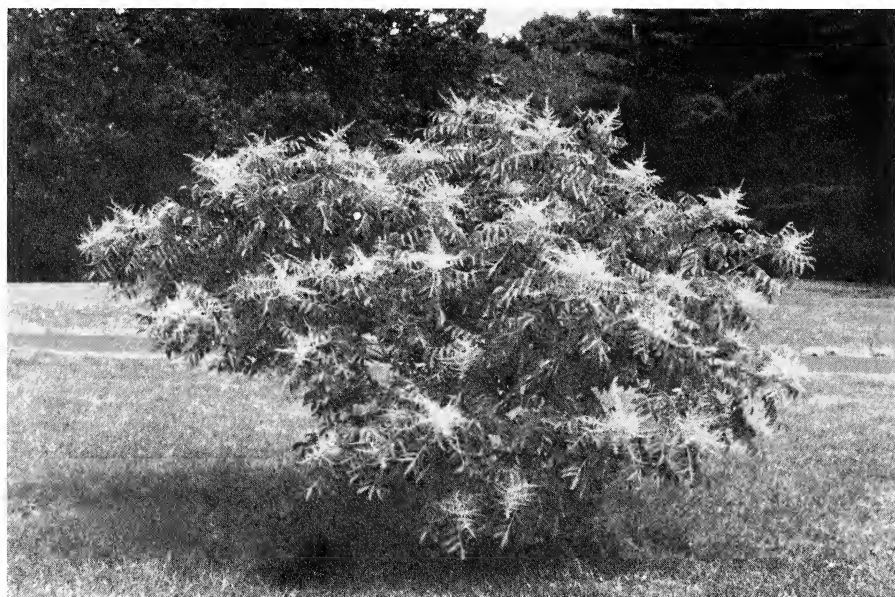
ZONE: 5

ENVIRONMENT: full sun; widely adaptable to wet to dry soil; more pH adaptable than pin oak

This species is often confused with red, scarlet and pin oaks and appears to have potential for street and city use. The lustrous, dark green leaves turn red in fall. It is found in the wild on a wide range of sites, varying from stream banks and bottomlands to dry uplands and ridges. It is apparently more difficult to transplant than pin and red oaks. Trees for northern areas should be grown from seed collected at the northern edge of the range. A tree in the Secrest Arboretum, Wooster, Ohio, grew 50 feet in twenty-five years.

*Rhus chinensis*

## Chinese Sumac



HEIGHT: 15-18 feet

SPREAD: variable

HABIT: loose, suckering shrub or can be grown as a small, round-headed, flat-topped tree

ZONE: 5

ENVIRONMENT: full sun; adaptable to poor soil conditions

This species is not well known in this country because of the native and more popular *Rhus glabra* and *R. typhina*. The habit is extremely variable, ranging from a large colonizing shrub to a small tree. The rich green foliage changes to yellow, orange and red in fall. Showy terminal panicles of yellowish-white flowers open in August and September and are followed by orange-red drupes. The species is useful for banks, cuts and fills, and other poor soil areas, and is difficult to kill once established. Root cuttings are the preferred method of propagation.

*Sorbus esserteauiana*

## Chinese Mountain-ash



HEIGHT: 20-30 feet  
 SPREAD: 15-20 feet  
 HABIT: upright-oval

ZONE: 5 (4?)  
 ENVIRONMENT: full sun; well-drained soil; pH adaptable

At the Arnold Arboretum, this is one of the best trees for autumn color with foliage in brilliant shades of yellow, orange, red, and bronze. It is a deciduous plant with large terminal clusters of small, creamy-white flowers in May. The orange to scarlet fruit is ornamental in late September and October, but is quickly eaten by birds. This species may be susceptible to borers and to fire blight. It probably will be most successful from an ornamental and cultural standpoint when grown in colder regions of the country.

***Symplocos paniculata***

**Sapphireberry**



**HEIGHT:** 15-20 feet

**SPREAD:** 10-20 feet

**HABIT:** large, multistemmed shrub;  
upright-arching branches; almost  
honeysuckle-like in outline

**ZONE:** 5

**ENVIRONMENT:** full sun; well-drained,  
acid to neutral soil





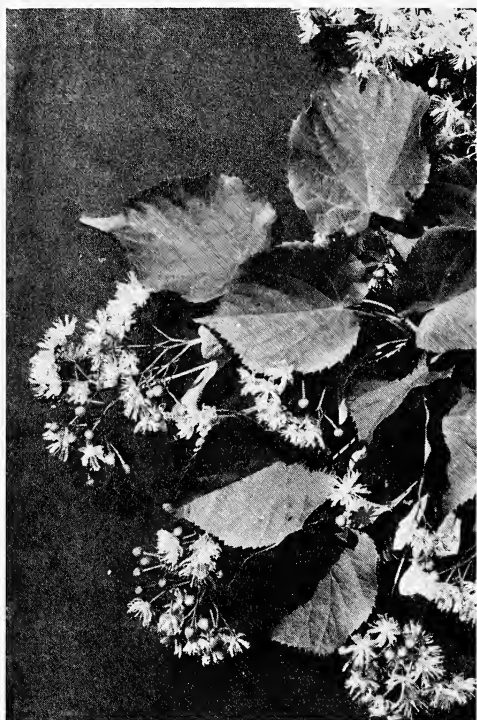
This most unusual fruiting shrub is one that is not well-represented in American landscapes. The rich green foliage is insect and disease free. The creamy-white, fragrant flowers open in May and are followed by sapphire-blue fruits in September. Unfortunately, the fruits are often consumed by birds. Flowering and fruiting tend to be heaviest in alternate years. The authors have seen tree forms that might be suitable for wide parkways. Usually the plant is multi-stemmed and could be utilized best along freeways for mass effect or in large planting islands. Sapphireberry also might be a good shrub for above-ground containers. The species is long-lived, structurally sound and requires minimal maintenance to keep it in presentable condition.

*Tilia japonica*

**Japanese Linden**







HEIGHT: 50-60 feet  
 SPREAD: 20-30 feet  
 HABIT: distinctly pyramidal with billowy foliage masses; resembles *T. cordata* in outline

ZONE: 5  
 ENVIRONMENT: full sun; moist, well-drained soils; pH adaptable

This is a rare linden, with dark green foliage and abundant creamy-yellow flowers in July. It is texturally different from *Tilia cordata* and more graceful in outline. Its use would add species diversity. Laboratory tests have shown the plant to be stem hardy to  $-49^{\circ}\text{F}$ .

### ***Tilia mongolica***

### **Mongolian Linden**

HEIGHT: 30-45 feet  
 SPREAD: 25-55 feet  
 HABIT: not the typical pyramidal outline of most *Tilia* species; tends to be loose, floppy, and irregular; some branches show a slight pendulous tendency

ZONE: 4  
 ENVIRONMENT: see *T. cordata*

Another rare linden, *Tilia mongolica* is not as handsome as *T. japonica* or *T. cordata*. The lustrous, dark green foliage is deeply incised and appears grape-like. The winter stem color is often listed as red, but on the Arnold Arboretum tree is reddish-brown. The yellowish-white flowers open in July. This linden is more prone to storm damage than most others. It does not develop a uniform head without considerable pruning, but it may prove to be useful in containers where other lindens would be too large.

*Zelkova carpinifolia*

**Elm Zelkova**



**HEIGHT:** 40-70 feet

**SPREAD:** 20-50 feet

**HABIT:** conical to oval-rounded;  
variable when grown from seed;  
branching tends to be strongly  
upright

**ZONE:** 6

**ENVIRONMENT:** full sun; well-  
drained soil; pH adaptable

Longevity, structural strength, and distinctive exfoliating bark make this a highly desirable tree. It is a slow grower, and nurserymen state that it takes too long to reach saleable size to be productive from the commercial viewpoint. For those willing to wait for a good thing, this tree is exceptionally long-lived: two hundred- to three hundred-year-old specimens are common in Europe. Young trees have smooth gray bark; on older specimens it is exfoliating, revealing colors of tan, green and pale orange against a background of gray. Elm zelkova is extremely variable in shape when grown from seed, therefore grafted selections are preferable. One specimen that is 60-80 feet high and 15-18 feet wide grows along the reflecting basin at the foot of the Capitol Building in Washington, D.C. In the winter landscape this one specimen stands out from all neighboring trees because of its distinct habit and bark. The species is susceptible to Dutch elm disease.

### *Zelkova sinica*

### Chinese Zelkova



HEIGHT: 30-50 feet

SPREAD: 20-40 feet

HABIT: rounded to somewhat vase-shaped; not unlike *Z. serrata* in outline; often multiple-stemmed

ZONE: 6

ENVIRONMENT: full sun to light shade; well-drained soil; pH adaptable

This slow-growing tree remains in scale with small landscape spaces for years. When young, it has smooth, gray bark which, with age, exfoliates in patches, revealing colors of gray, beige, and pale green. The tree is often multistemmed with strongly ascending branches; with proper pruning it can be headed up into a street tree. The foliage assumes tints of golden-brown in autumn. Its hardiness is suspect below  $-5^{\circ}$  to  $-10^{\circ}\text{F}$ . Two-year-old stock was severely injured in Illinois, and trees in the Morton Arboretum, Lisle, Illinois, have struggled; at the Arnold Arboretum, mature trees have developed frost cracks on the trunk.

## EVERGREEN SCREENING PLANTS

Evergreens are needed to block, frame, and direct views. They also provide visual interest and relief where the predominate vegetation is deciduous.

Needled and broadleaved evergreens are more prone to damage from aerial salts, atmospheric pollutants, and desiccating winds because the foliage is retained throughout the seasons. Once the foliage is damaged, the injured portions remain visible for long periods. In general, evergreens are not used for street trees in the classical sense because they block vision and cast shadows which slow down the melting of ice and snow. They are often used, however, in groups or masses at considerable distances from the highway's edge.

The plants that follow have been included because they exhibit the greatest adaptability to adverse environmental conditions. White pine, *Pinus strobus*, and Canadian hemlock, *Tsuga canadensis*, are not included because of their sensitivity to salts and atmospheric pollutants.

*Cedrus atlantica*

Atlas Cedar



HEIGHT: 50-70 feet

SPREAD: 40-60 feet

HABIT: pyramidal in youth; irregular and spreading with age

ZONE: 6

ENVIRONMENT: full sun; appears to be more tolerant of aerial salts than most evergreens; pH adaptable

Atlas cedar tends to be strongly pyramidal for the first fifteen to twenty-five years, after which time it begins to spread and becomes more open. Needles vary from green (on the type) to silvery-blue on the cultivar 'Glauca'. *Cedrus atlantica* is reported to be difficult to transplant. The authors have seen young plantings in parking lots and in narrow spaces along major roadways where the plants show no signs of stress. Observations at Kew Gardens in England indicate that this species is more tolerant of drought and atmospheric pollution than *C. deodora* or *C. libani*. Disadvantages include stiff, coarse texture compared to other species, lack of shade tolerance, needle dieback in cold winters, and infestations of *Diplodia* tip blight in humid areas. A useful cultivar for restricted growing areas is 'Fastigiata'. *C. deodara*, Deodar cedar, is more graceful than *C. atlantica* and also is easier to transplant. Additionally, two cultivars, 'Kashmir' and 'Kingsville', are supposedly hardy to  $-25^{\circ}\text{F}$ ; however, these clones have not proven hardy to  $-5$  to  $-10^{\circ}\text{F}$  in Midwestern tests. The Arnold Arboretum has a hardy selection called 'Shalimar' that is far superior to either cultivar.

### *Chamaecyparis pisifera*

### Sawara False-cypress



HEIGHT: 20-50 feet

SPREAD: 10-20 feet

HABIT: pyramidal

ZONE: 5

ENVIRONMENT: full sun; moist to dry, well-drained soil; pH adaptable

Sawara false-cypress exhibits great variation in form, foliage color, texture, and growth rate. While most cultivars are somewhat slow in growth, they are long-lived and dependable. Young plants tend to be dense and clad with branches directly to the ground. Older specimens are often bare toward the base, and the upper canopy becomes thin and layered in appearance. Trunks are usually straight and tall, and walking through a mature grove would be a delightful experience. *Chamaecyparis pisifera* exhibits tolerance to aerial salts but is intolerant of shading. Older specimens of some cultivars have thinned out or exhibit browned interior leaves due to self-shading. Some cultivars have an unattractive yellow-green winter foliage color. The most useful cultivars for highway screening include 'Plumosa' — conical with bright green, feathery foliage, and 'Squarrosa' — pyramidal with soft blue-gray foliage. This species suffers from a lack of creative landscape use.

### *Chamaecyparis thyoides*

### Atlantic White Cedar



HEIGHT: 20-50 feet

SPREAD: 10-15 feet

HABIT: columnar to narrow-pyramidal

ZONE: 5

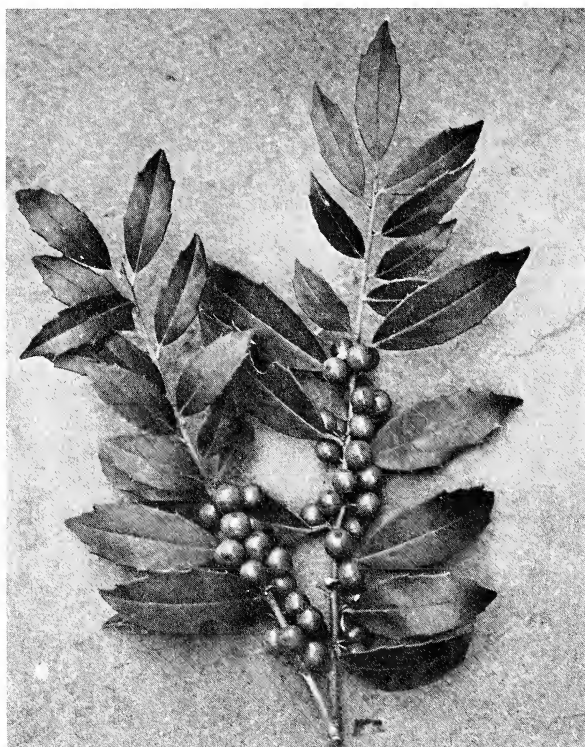
ENVIRONMENT: full sun to light shade; moist to wet soils that are rich in organic matter

This neglected and under-utilized American conifer is a good choice for poorly drained areas. Individual plants are full and dense, with a narrow, upright form. In nature, the plant is most commonly found in dense colonies in swampy soils. Atlantic white cedar is free from insects and diseases. The wood is extremely durable and structurally strong. Large isolated specimens are subject to wind-throw in severe storms. The species adapts to use as a tall, informal hedge or screen plant and perhaps is best used in low-stress situations.

### *Ilex ciliospinosa*

HEIGHT: 12-15 feet  
SPREAD: 4-6 feet  
HABIT: narrowly upright

ZONE: 5  
ENVIRONMENT: full sun to moderate shade; prefers a moist, well-drained soil; pH adaptable



Due to cold hardiness, this holly is one of the more successful evergreen species in the Arnold Arboretum. Its narrow, almost columnar habit makes it useful in restricted growing areas. The foliage is a dull yellow-green. Pistillate plants bear clusters of bright red, pea-sized fruits that ripen in early September and remain into December. Fruiting tends to occur in alternate years. During the winter of 1977-'78 (low of  $-5^{\circ}\text{F}$ ), plants were defoliated but recovered. Without periodic pruning, the plants become leggy and unattractive. As with other hollies, both staminate and pistillate plants are required for fruit production.



*Ilex opaca***American Holly**

HEIGHT: 40-70 feet  
 SPREAD: 20-40 feet  
 HABIT: densely pyramidal with  
 branches to the ground

ZONE: 6

ENVIRONMENT: full sun to partial  
 shade; moist, well-drained, acid soil;  
 shows good air pollution and salt  
 spray tolerance

This species is seldom considered for street or city use but may deserve a place. The foliage varies from dark green to yellow-green, and the fruit, from yellow to red. American holly tends to be low-branched, which would visually obstruct traffic. Slow growth also may limit use. Fruit size and persistence depend on the cultivar, as does leaf color. Although *Ilex opaca* does display great resistance to aerial salts, leaf miner and berry midge are two serious problems. From the coast of New England southward, however, the species is vigorous, adaptable and dependable. Laboratory hardiness tests have indicated that young stems are hardy only to  $-13^{\circ}\text{F}$ . Numerous cultivars have been selected and a list of the more hardy types should be compiled.

*Ilex pedunculosa*

Longstalk Holly



HEIGHT: 15-20 feet

SPREAD: 10-15 feet

HABIT: large evergreen shrub or low  
branched tree of dense pyramidal-  
oval to pyramidal-rounded outline

ZONE: 5

ENVIRONMENT: full sun or partial  
shade; best growth is achieved in acid,  
moist, well-drained soils; appears  
more tolerant of drought and wind  
than many hollies

This species is little known compared to American holly (*Ilex opaca*) but certainly deserves wider use. Its lustrous, dark green leaves are shaped like those of *Kalmia latifolia*, mountain laurel. The ¼-inch-diameter red fruits are borne on 2-inch-long stalks in September, and are consumed rather quickly by the birds. This species would make an excellent screen and perhaps has possibilities as a container plant. At the Arnold Arboretum, large established plants have been infected by twig dieback (*Phytophthora*) which, in severe cases, caused loss of the plants. The species is easily rooted from cuttings taken through summer and fall. A staminate plant is necessary for pollination.

*Juniperus chinensis*

**Chinese Juniper**



**HEIGHT:** 20-30 feet  
**SPREAD:** 10-20 feet  
**HABIT:** usually pyramidal in outline

**ZONE:** 4  
**ENVIRONMENT:** full sun; dry to infertile, sandy soils; pH adaptable

This excellent evergreen is especially tolerant of aerial salt spray, heat, drought and urban conditions, under which it remains persistent and long-lived. Shade intolerance and occasional infestations of bag worms and red spider are disadvantages. Superior forms include 'Columnaris', which grows 15-20 feet tall and 6-8 feet wide, forming a superb tall hedge; and 'Keteleeri', which grows 25-30 feet tall and 6-10 feet wide. Other types like 'Pfitzeriana', 'Hetzii', var. *sargentii*, and 'Old Gold' can be used for bank and large area plantings. The authors have observed effective plantings of Pfitzer juniper that covered entire slopes, suppressed weed growth, and resisted salt spray.

### *Juniperus virginiana*

### Eastern Red Cedar



HEIGHT: 30-50 feet

SPREAD: 10-20 feet

HABIT: variable, from columnar to upright-oval to pyramidal to broad-pyramidal

ZONE: 3

ENVIRONMENT: full sun; poor, gravelly soils; tolerant of heat, drought and cold; resistant to saline conditions; excellent for calcareous (high pH) soils

Eastern red cedar is one of the commonest and most adaptable pioneer evergreens, for it quickly invades abandoned fields and highway cuts. Foliage is generally a medium green but varies to gray-green. Plants bear quantities of blue-gray, fleshy, berrylike cones that are ornamental. The bark of old plants is reddish-brown in shredding strips. The plant's greatest merits are durability, long life, and cultural adaptability. It tends to be a slow grower and displays significant variability in growth habit, foliage color, and coning characteristics when grown from seed. Selections include 'Burkii' — blue-green summer foliage becoming purplish in winter, pyramidal form to 10-15 feet tall; 'Canaertii' — dense foliage of a rich green color, abundant bluish cones contrasting well with the foliage, rust-prone, upright to 20-30 feet; 'Glauca' — silver-blue foliage, dark green cones, narrowly upright to 20 feet; 'Grey Owl' — spreading type with blue-green foliage, grows 4-6 feet high; 'Silver Spreader' — similar to above (both of these spreading types are effective and might be used where the soils are dry and calcareous); 'Hillii' — blue-green summer foliage becoming purplish in winter, slow grower, dense and columnar, to 15 feet tall; 'Nova' — narrow, upright with a mature height of 10-12 feet.

### *Picea omorika*

### Serbian Spruce



HEIGHT: 50-60 feet (80 feet)

SPREAD: 15-20 feet or less

HABIT: evergreen with a remarkably slender trunk and short ascending or drooping branches forming a narrow pyramidal outline

ZONE: 4

ENVIRONMENT: full sun; prefers moist, well-drained soil; tolerates air pollution; pH adaptable and a good choice for calcareous soils

*Picea omorika* is little known and used as a landscape plant in North America but it has proved to thrive better than any other landscape spruce in London, England. A graceful, spirelike outline, lustrous, dark green leaves and retention of lower branches in old age make this a first choice among spruces. It should be tested in malls, parks or along freeways where environmental pollutants might limit the successful culture of other spruce. Serbian spruce is a first choice among evergreen screening plants for areas where horizontal growing space must be restricted.

### *Picea orientalis*

### Oriental Spruce



HEIGHT: 50-60 feet

SPREAD: 10-20 feet

HABIT: a dense, compact pyramid in youth which becomes more graceful with age and maintains a full complement of branches to the ground

ZONE: 5, possibly 4

ENVIRONMENT: full sun; requires moist, well-drained soil for best growth; pH adaptable; foliage may burn in exposed locations especially where temperature drops below  $-20^{\circ}\text{F}$

The short, ¼- to ½-inch-long, lustrous, dark green needles are densely set along the branches on the Oriental spruce. The species makes a good screen or can be used in groups or masses. For park and large area use it is a valuable alternative to pines. Among the spruces, this ranks second to *Picea omorika* in terms of aesthetic qualities.

***Picea pungens* var. *glauca***

**Colorado Blue Spruce**



**HEIGHT:** 30-60 feet

**SPREAD:** 10-20 feet

**HABIT:** a narrow to broad symmetrical pyramid with stiff, horizontal branches to the ground

**ZONE:** 2

**ENVIRONMENT:** full sun; one of the better spruces for dry soils; tolerates city conditions; pH adaptable



This plant has wide appeal because of the bluish-green to blue cast of the needles, but it is a stiff and formal plant and difficult to blend into the landscape. It displays good tolerance to aerial salts, in part because the wax deposits on the surface of the needles prevent accumulation of the sodium and chloride ions. Cultivars 'Hoopsii', 'Moerheimii', and 'Thompsonii', are among the best for intense silver-blue to blue needle color. Colorado blue spruce is a first choice among landscape conifers for cold northern locations.

### *Pinus nigra*

### Austrian Pine



HEIGHT: 50-60 feet

SPREAD: 20-40 feet

HABIT: densely pyramidal in youth,  
becoming umbelliform with maturity

ZONE: 4

ENVIRONMENT: sun; tolerates heat,  
drought and atmospheric pollution as  
well as salinity; pH adaptable

This is one of the most common landscape pines in areas where *Pinus strobus* does not perform well. Needles are dark green and lustrous. The bark on selected trees develops broad, flat ridges with interesting grays and brown. As a background plant along freeways, in parks, and on residential properties where polluted conditions prevail, it is perhaps the best pine. It has suffered from *Diplodia* tip blight, however, which may disfigure or kill susceptible mature trees. Recent research has shown that twenty-year-old trees were scarcely infected, while thirty-year-old trees were heavily infected.

## *Pinus sylvestris*

## Scotch Pine



**HEIGHT:** 30-60 feet

**SPREAD:** 30-40 feet

**HABIT:** irregularly pyramidal in youth, becoming open, wide-spreading and flat or round-topped (almost umbrella-shaped) at maturity

**ZONE:** 2

**ENVIRONMENT:** full sun; will grow in poor, dry sites; prone to wind desiccation and often turns yellow-green in winter; pH adaptable

Another popular landscape pine, this species is, however, extremely variable in needle color (blue- to yellow-green) and in habit. The orange, scaly bark is attractive on old trees. *Pinus sylvestris* is too irregular for street tree use but looks well in groupings, groves, or masses along interstate highways. It shows moderate tolerance to deicing salts but probably should be recommended only for temporary purposes since it is not long-lived under high stress situations. It, too, is susceptible to *Diplodia* tip blight.

*Pinus thunbergiana*

Japanese Black Pine



HEIGHT: 20-40 feet  
 SPREAD: variable  
 HABIT: irregular in youth and old age; often sprawling

ZONE: 6  
 ENVIRONMENT: full sun; adaptable to heavy or sandy soils; extremely salt tolerant

Probably the most salt-tolerant pine, this is a good choice where deicing salts or ocean spray present a cultural problem. The severely cold winters of 1976-'77 and '77-'78, however, induced severe needle browning and killed many Japanese black pines in the Midwest. The lustrous, dark green needles are similar to those of *Pinus nigra*. *P. thunbergiana* tolerates sandy, infertile soils as well as any pine. The irregular habit limits street use, but for groupings, massed and shelter plantings, the species has merit.

***Sciadopitys verticillata***

**Japanese Umbrella-pine**



**HEIGHT:** 20-40 feet

**SPREAD:** 10-20 feet

**HABIT:** stiffly pyramidal and formal in youth; irregular and more graceful with age

**ZONE:** 5

**ENVIRONMENT:** full sun to light shade; moist, well-drained soil; tolerant of exposure to wind and air-borne salt spray

Umbrella-pine is recommended here because it is proving to be extremely durable under difficult growing conditions. The authors have seen one hundred-year-old plants growing on the island of Martha's Vineyard, Massachusetts. The plants, within a block of the ocean, are growing in infertile, dry, sandy soil. Although exposed to the full onslaught of winter gales, they appear to be both structurally sound and vigorous. Several factors limiting use are high purchase cost, slow growth, and the stiff, formal appearance of young plants. Bark on old plants is cinnamon-brown and shredding. The foliage is lustrous, dark green and very exotic in appearance. This plant is an excellent choice for parks and wide, planting islands, and perhaps for above-ground containers. It is more vigorous in the northeastern and northwestern United States because of cooler summer temperatures there.

***Thuja occidentalis***

**American Arborvitae**



**HEIGHT:** 20-40 feet

**SPREAD:** 10-15 feet

**HABIT:** densely foliaged; narrow to broad pyramid, with short ascending branches to the ground that end with flat, spreading, horizontal sprays

**ZONE:** 2

**ENVIRONMENT:** full sun; prefers moist, well-drained soil; adaptable to wet and dry soils; pH adaptable

This species and its numerous cultivars have been widely employed for residential landscaping. The medium green foliage often turns a yellow-brown in winter. The tree makes a functional screen or privacy barrier and could be used effectively in containers. It is easily pruned and can be maintained at any height. Limitations include structural damage from ice and snow, which detracts from landscape uniformity. Two selected cultivars, 'Techny' and 'Nigra', maintain dark green foliage through the winter but are slower growing than the species. 'Hetz Wintergreen' is narrowly upright with a strong central leader; its foliage is a glossy dark green throughout the year.

### *Thuja plicata*

### Western Arborvitae



HEIGHT: 50-70 feet

SPREAD: 15-25 feet

HABIT: narrow, pyramidal with a buttressed base; very dense and full with a complement of branches to the ground

ZONE: 5

ENVIRONMENT: full sun to partial shade; moist, well-drained, fertile soils; moist atmosphere; pH adaptable

This beautiful conifer is superior to *Thuja occidentalis*, especially in the quality of its winter foliage color which is a uniform dark green in summer as well. It makes a superlative screen, hedge, or group. It is probably less tolerant of polluted conditions and poor soils than *T. occidentalis*. The light brown to cinnamon-red shredding bark is attractive. Apparently there are different races of this species in cultivation, for some show a lack of cold hardiness. 'Atrovirens' is reliable in Zone 5 and the Arnold Arboretum accessions exhibit good cold tolerance.



*PERTINENT CHARACTERISTICS OF STREET TREES*

The following charts are included to assist readers in the selection of plants for specific characteristics. Obviously, the placement of plants within the categories is somewhat arbitrary, for each tree is a unique living organism affected by genetics, climate, soil, environment, and man. The size groups in general reflect the growth of the species under landscape conditions.

The letter following the name of each deciduous tree refers to the major group in which the tree is included.

- P = Primary List
- S = Secondary List
- T = Trial List

For the readers' convenience, the page number for each plant description is listed in the right-hand column.



*Acer platanoides 'Globosum' is an effective, small, round-headed tree.*



difficult sites  
containers  
high pH (alkalinity)  
aerial salts  
drought  
wet soil  
sun  
light shade

Deciduous Trees—  
30 Feet or Less

flowers  
fruit  
autumn color  
ornamental bark  
rapid growth

<i>Acer buergeranum</i> (P)	✓	✓	✓	✓	✓	84
<i>Acer ginnala</i> (S)	✓	✓	✓	✓	✓	139
<i>Acer griseum</i> (S)	✓	✓	✓	✓	✓	140
<i>Acer maximoviczianum</i> (S)	✓	✓	✓	✓	✓	141
<i>Acer tataricum</i> (S)	✓	✓	✓	✓	✓	143
<i>Amelanchier arborea</i> (P)	✓	✓	✓	✓	✓	93
<i>Catalpa ovata</i> (T)	✓	✓	✓	✓	✓	174
<i>Chionanthus retusus</i> (T)	✓	✓	✓	✓	✓	176
<i>Cornus alternifolia</i> (T)	✓	✓	✓	✓	✓	177
<i>Cornus kousa</i> (P)	✓	✓	✓	✓	✓	98
<i>Cornus mas</i> (P)	✓	✓	✓	✓	✓	100
<i>Cornus officinalis</i> (P)	✓	✓	✓	✓	✓	101
<i>Crataegus crus-galli</i> (P)	✓	✓	✓	✓	✓	102
<i>Crataegus laevigata</i> 'Paulii' (S)	✓	✓	✓	✓	✓	149
<i>Crataegus laevigata</i> 'Superba' (T)	✓	✓	✓	✓	✓	181
<i>Crataegus</i> × <i>lavallei</i> (S)	✓	✓	✓	✓	✓	150
<i>Crataegus phaenopyrum</i> (P)	✓	✓	✓	✓	✓	103

LANDSCAPE  
ATTRIBUTES

Deciduous Trees—  
30 Feet or Less

ENVIRONMENT (tolerant of)

difficult sites	containers	high pH (alkalinity)	aerial salts	drought	wet soil	sun	light shade	flowers	fruit	autumn color	ornamental bark	rapid growth	Page
✓	✓			✓		✓		✓	✓				181
✓	✓			✓		✓		✓	✓	✓			104
	✓	✓	✓	✓		✓						✓	151
						✓	✓	✓		✓	✓		154
				✓	✓	✓	✓	✓		✓	✓		115
				✓	✓	✓	✓	✓		✓	✓		116
✓	✓			✓		✓	✓	✓	✓	✓	✓	✓	118
						✓		✓					194
				✓		✓		✓	✓	✓	✓	✓	194
						✓		✓		✓	✓		158
✓	✓			✓		✓	✓	✓		✓			126
✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	198
						✓		✓	✓	✓			199
	✓	✓		✓		✓	✓	✓	✓				200
	✓	✓		✓		✓		✓			✓		165

# ENVIRONMENT (tolerant of)

## Deciduous Trees— 30-50 Feet

# LANDSCAPE ATTRIBUTES

difficult sites	containers	high pH (alkalinity)	aerial salts	drought	wet soil	sun	light shade	LANDSCAPE ATTRIBUTES					Page
								flowers	fruit	autumn color	ornamental bark	rapid growth	
✓	✓	✓	✓	✓	✓	✓	✓		✓				85
								<i>Acer campestre</i> (P)					
✓	✓	✓	✓	✓	✓	✓	✓	<i>Acer cappadocicum</i> (T)					169
								<i>Acer pseudoplatanus</i> (P)		✓	✓	✓	88
		✓	✓	✓	✓	✓		<i>Aesculus</i> × <i>carnea</i> 'Briotii' (P)	✓				91
✓	✓	✓	✓	✓	✓	✓	✓	<i>Alnus cordata</i> (T)				✓	170
✓	✓	✓	✓	✓	✓	✓	✓	<i>Alnus glutinosa</i> (T)				✓	171
✓	✓	✓	✓	✓	✓	✓	✓	<i>Carpinus betulus</i> (P)			✓		95
								<i>Carpinus tschonoskii</i> (T)			✓		173
✓	✓	✓	✓	✓	✓	✓	✓	<i>Celtis jessoensis</i> (T)			✓		175
								<i>Cercidiphyllum japonicum</i> (S)		✓	✓	✓	147
		✓	✓	✓	✓	✓	✓	<i>Cladrastis lutea</i> (S)	✓	✓	✓		148
								<i>Cornus controversa</i> (T)	✓	✓			178
								<i>Cornus macrophylla</i> (T)	✓	✓			179
✓	✓	✓	✓	✓	✓	✓	✓	<i>Corylus colurna</i> (T)	✓		✓		180
	✓	✓	✓	✓	✓	✓		<i>Eucommia ulmoides</i> (T)					182
✓	✓	✓	✓	✓	✓	✓	✓	<i>Fraxinus nigra</i> (T)				✓	183



ENVIRONMENT (tolerant of)							Deciduous Trees – 30-50 Feet	LANDSCAPE ATTRIBUTES					Page	
difficult sites	containers	high pH (alkalinity)	aerial salts	drought	wet soil	sun		light shade	flowers	fruit	autumn color	ornamental bark		rapid growth
✓	✓	✓	✓	✓	✓	✓			✓			✓		160
		✓	✓	✓	✓	✓						✓	✓	161
✓				✓		✓				✓	✓	✓	✓	163
		✓				✓			✓	✓	✓	✓		164
✓	✓	✓	✓	✓	✓	✓			✓					133
	✓	✓		✓	✓	✓			✓					202
✓	✓	✓	✓	✓	✓	✓							✓	167
✓	✓	✓		✓	✓	✓						✓	✓	136
				✓		✓					✓		204	

ENVIRONMENT (tolerant of)										Deciduous Trees— 50 Feet or More
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
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ENVIRONMENT (tolerant of)							LANDSCAPE ATTRIBUTES					Page		
Deciduous Trees— 50 Feet or More	difficult sites	containers	high pH (alkalinity)	aerial salts	drought	wet soil	sun	light shade	flowers	fruit	autumn color	ornamental bark	rapid growth	
						✓	✓		✓	✓	✓		✓	114
			✓				✓		✓				✓	153
		✓	✓		✓		✓			✓	✓	✓	✓	189
	✓	✓	✓	✓		✓	✓	✓	✓				✓	190
				✓		✓	✓		✓	✓				156
	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	122
			✓				✓		✓	✓				196
							✓						✓	197
						✓	✓							161
	✓					✓	✓				✓		✓	127
						✓	✓							128
	✓	✓	✓	✓	✓		✓	✓					✓	129
	✓						✓				✓		✓	130
						✓			✓	✓			197	
		✓		✓		✓			✓	✓		✓	131	



ENVIRONMENT (tolerant of)							Deciduous Trees— 50 Feet or More	LANDSCAPE ATTRIBUTES				Page	
difficult sites	containers	high pH (alkalinity)	aerial salts	drought	wet soil	sun		light shade	flowers	fruit	autumn color		ornamental bark
✓	✓	✓	✓	✓	✓	✓		<i>Taxodium distichum</i> (S)		✓		✓	166
✓		✓	✓	✓		✓		<i>Tilia cordata</i> (P)		✓			132
		✓		✓		✓		<i>Tilia japonica</i> (T)		✓			201
		✓		✓		✓		<i>Tilia tomentosa</i> (P)		✓			134
		✓		✓		✓		<i>Zelkova carpinifolia</i> (T)				✓	203
✓	✓	✓	✓	✓	✓	✓		<i>Zelkova serrata</i> (P)		✓	✓	✓	137



LANDSCAPE  
ATTRIBUTES

Evergreen Screening  
Plants-30-50 Feet

ENVIRONMENT (tolerant of)							fruit	ornamental bark	rapid growth	Page
difficult sites	containers	high pH (alkalinity)	aerial salts	drought	wet soil	sun				
✓		✓	✓	✓		✓				215
✓		✓	✓	✓		✓		✓		216
		✓		✓		✓		✓		217
✓			✓	✓		✓				218

Evergreen Screening  
Plants-50 Feet or More

	✓	✓	✓	✓	<i>Cedrus atlantica</i>	205
✓	✓	✓	✓	✓	<i>Picea omorika</i>	213
	✓	✓	✓	✓	<i>Picea orientalis</i>	214
				✓	<i>Thuja plicata</i>	221

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THE HUNDRED FINEST TREES AND SHRUBS FOR TEMPERATE CLIMATES

TREE AND SHRUB FORMS — THEIR LANDSCAPE USE

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## Notes

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## Notes



*Photo: E. Gray*

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# ARNOLDIA

*The Arnold Arboretum*  
Vol. 39, No. 4     July/Aug. 1979



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*The staff of the Arnold Arboretum is pleased to dedicate this issue of Arnoldia to Jeanne S. Wadleigh who served so ably as its editor for the past seven years. During her tenure Jeanne instituted two major innovations in the journal, both of which have greatly expanded its scope. The regular feature "Notes from the Arnold Arboretum" informs our readers of staff changes and activities and other Arboretum happenings. And the series of handbooks which have appeared as issues of Arnoldia have provided exhaustive and authoritative treatments of various botanical and horticultural subjects. It is particularly appropriate to dedicate this issue of Arnoldia to Jeanne since she worked closely with Mrs. Morss to bring the text of the major article nearly to its final form.*

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# ARNOLDIA

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RICHARD E. WEAVER, JR., Editor

NORTON BATKIN, Managing Editor

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Front cover: ALLIUM. A woodcut from *De historia stirpium*, Leonhard Fuchs. See page 259.

Credits: All the illustrations to "Landscaping with Herbs" are reproduced from books in the Arnold Arboretum collection on deposit with the Houghton Library of Harvard University. Photographs of the originals were made by Barry Donohue and Michael Nedzweski of the Fogg Museum's Department of Photographic Services. We wish to thank the staff of the Houghton Library and of the Fogg Museum's Department of Photographic Services for their aid in securing the illustrations for this article. In preparing the captions to the illustrations, reference was made to Agnes Arber, *Herbals: Their Origin and Evolution* (Darien, Connecticut: Hafner Publishing Co., 1970).



A hand-colored woodcut from *Das puch der natur*, Konrad von Megenberg. Printed in Augsburg by H. Bämler, 1475. *Das puch der natur* was multiplied in manuscript before it was printed as a book; at least 35 manuscript copies exist. According to Agnes Arber (*Herbals: Their Origin and Evolution*, 1970), it contains the earliest known botanical woodcuts that are not merely decorations. Among the plants in this woodcut are a buttercup and a violet.

# Landscaping with Herbs

by ELISABETH W. MORSS

Herbs have always travelled with people, from a remote past to the present. Around the world, they are the group of plants which, in special ways, became indispensable to man's well-being and then were associated with symbol and tradition. Never a static gathering, they have long flourished in gardens and have been overlooked as material for landscaping. My personal thought about landscaping vs. garden is that garden tends to concentrate upon specific location while landscaping is a response to area. One may have landscaping with or without garden but not necessarily the reverse. So often a garden absorbs something from its setting that gives at least a sense of landscaping. It may be proximity to a house, the importance of a tree, the suggestion of more to follow implicit in a gate. Many gardens are held closely to their plans; landscaping usually has to acknowledge maturing trees and shrubs and neighborhood development.

In landscaping, just as in gardens, herbs can achieve a marvelous

*Mrs. Morss is a longtime Friend of the Arnold Arboretum and in fact this article was solicited as a result of a lecture which she presented in a recent "Evenings with Friends" series. Her experience with herbs is extensive. She has lectured widely and she has grown herbs for more than thirty years. She has served on the National Executive Board of The Herb Society of America. Mrs. Morss is the author of Herbs of a Rhyming Gardener. Herb growers also might be interested in Mrs. Morss's low-maintenance methods of winter covering and mouse control, published in her article "Of Mice and Mulch", The Herb Grower Magazine, Vol. XXIII, No. 3, 1970 (Falls Village, Connecticut).*

informality or take on the tautness of disciplined line. At one extreme, they blend with natural features and at another, enter into the sophistication of modern architecture. Because they originated in widely differing habitats, there are varieties adaptable to almost any situation. Formality with herbs recalls measured patterns in edgings and knots and cleverly arranged paths and beds. Informality has a visual effect that is pleasantly relaxed, as in the restoration of a colonial American housewife's luxuriant tangle of herbs and cherished plants, or an English cottage garden. For several hundred years cottage gardens have been the small home-gardens of England's towns and villages. They were mainly long-continuing gardens, slow to change in plant and style. They produced a surprising quantity of flowers, herbs, vegetables and fruits, and a visitor to England still looks forward to seeing them as part of the scenery. Their comparative naturalness inspired 19th century garden design and impressions of color and season. Landscaping with herbs borrows from the formal and the informal, with its own freedom and constraints.

Herbs are as available for use in landscaping as they are in a garden, and one should note a few cautions before designing and planting with them. Allergenic, poisonous and powerfully medicinal herbs must be located safely beyond touch and taste. Pesticides should be non-toxic to humans, pets, bees and birds. Conformance to Latin names is necessary for herbal uses and for botanical accuracy. The owner and landscape architect share a responsibility to avoid herbs whose spread might prove detrimental to a locality and agriculture. Also, because they can be put to use, some herbs may need the visual compensation of other plants to fill in and mask when they are recovering from harvest or left to go to seed. This is a slight, but possibly required, factor in planning their succession of interest.

Examples: *Lamb's Ears*. For best foliage, one should sacrifice the flowers. There is, however, a non-flowering variety, 'Silver Carpet'. The silvery leaves are so deeply velvety that *Lamb's Ears* is a most appealing herb, formally and informally. Planted in sun, it picks up the color of lichens from more distant shade, and it is at home in sunny, naturalized areas, old-fashioned garden, edgings and blocks, with rocks, and in the landscaping for a skyscraper.

*Angelica*. *Angelica* offers an illustration of a landscaping dilemma with herbs. In its first year, *Angelica* is prettily leafy and an herb for middle ground. The second year, it sends up lanky flower-stalks and briefly accenting flower-heads and is for backgrounds. If it is allowed to self-sow, to grow naturally in place year after year, it looks dreadful. The best handling of *Angelica* is either to cut it back at some stage in its second year and compensate with plants of intermediate height, or to allot it space where its deterioration does not matter and one can dig up seedlings at will for transplanting.

When combining herbs and other landscaping plant-material it may help to think in "threes" and anticipate a design's unfolding:

the dominating, the supporting and the ambassador to the next. Each unit should be a single variety but may have several individual plants and clumps. The accent or contrast dominates; it draws immediate attention. The supporting is sympathetic. One relies upon it to set off the dominating and compensate where there is a gap or declining growth. The ambassador to the next is the connecting link between its "three" and the nearby grouping that is strongest visually. It is by no means a rule to think in "threes", simply an aid to visualizing, and one may not want "threes" at all, as when planting beside a rock, a tree or a garden accessory.

Examples: *Peony*. Dominating in flowers, it might play a supporting role or be an ambassador as a foliage plant.

*Lavender* (*Lavandula angustifolia*), *thyme* and *Germander* (*Teucrium chamaedrys*) could be "threes" in several designs: Germander in a clipped edging with Lavender on one side and on the other a path with creeping thymes among flagstones; Germander in a knot pattern with low thymes for filling and Lavender for accent in the knot or the background; Germander, Lavender and the tallest thymes growing informally together.

Where may herbs serve in landscaping? They belong wherever ground covers and foreground planting are wanted to enhance and bring unity. They also belong where vistas widen and setting becomes scenery.

Add herbs to transition zones of light, soil and scene. Let unusual foliage, height and mass establish distance and perspective and beckon to eye and mind. Evoke a smile with fragrance in the air and flowering for hummingbirds and butterflies. Improve the appearance of a garage or grading with herbs and at the same time create interest. Enliven the routine quality of year-round foundation evergreens and flowering shrubs with herbs that attain summer-shrub stature. With low-growing herbs, soften an edging too brightly flowered, a dividing-line too sharply encountered. The taller herbs that grow quickly enable temporary summer landscaping by form as well as foliage, and at moderate cost. Many of these herbs die, or die back to the ground, in winter and might be practical for areas which later receive winter snow-slides and plowed snow. If a house lot has room for only one tree, a drift of ground cover herbs and earliest spring bulbs under it seems magical.

Rock gardens are an ideal environment and setting for many herbs, in particular, the delicate wildflowers of herbal use. One must distinguish between a rockery, which is a pile of rocks and soil, and a rock garden, which is a designed and carefully constructed habitat conditioned by rocks. For landscaping, both local rock and rock that is imported will not look natural or in place unless they bear some relation to the geology and rock-weathering around them.

Herbs are more "contemporary" than may be supposed, combining well with landscaping concepts for modern buildings, abstract



A woodcut of plants from *Das puch der natur*. The German text of *Das puch der natur* is translated from a thirteenth century Latin compilation written by a student of Albertus Magnus (Bishop of Ratisbon, 1193–1280). The woodcuts on page 238 and above appear in the reverse order in *Das puch der natur*, which discusses man, animals and plants in an order which descends through creation according to the medieval Christian conception of a natural hierarchy.



sculpture and today's trend toward plantings in sand, stone chips, pebbles and organic mulches that reflect an Asiatic influence. To heighten natural features, there are herbs for landscaping beside water and every sort of path, and up and down slopes, terracings and rock faces. Herbs are supreme for merging space that is maintained with natural windbreaks and meadow and woodland boundaries and can be the native plants to remind the viewer of locality and season. In certain cases their history also may make them appropriate. They retain distinction, and their foliage can achieve a painterly joy. It even is possible to landscape totally with an herbal criterion; there are trees and shrubs which have herbal usage.

Container growing is suited to a number of herbs, whether in the tub or planter that accents or the opening in pavement or masonry wall that is, in a sense, container-growing. The newest structural containers are designed for planting at various levels within a limited space, perhaps for children, the elderly and the handicapped. Containers answer questions of special plant requirements and are a convenience in replacing plants past peak and holding over non-hardy perennial herbs for the winter.

As with most plants, a selection of herbs is often narrowed by environment, plant to plant compatibility, cost and maintenance. How one starts to design and select matters less than making a realistic advance appraisal of the site and of the care that one could provide. Before deciding upon plants, try to see them growing locally, in the wild or as escapes and under cultivation. Be alert for satisfying and successful combinations. Jot down effects in nature that might be translated, perhaps on a far smaller scale. Where is it that plants really grow, and why do ferns seem cooling on a hot day and autumn leaves more vivid in front of conifers? Stay true in design and planting to the landscaping's basic intent. With herbal use stressed, there are temptations among the ornamentals and garden hybrids within a genus, as among the salvias and artemisias. One can so easily include too much.

Example: *Rose*. Queen of flowers and fragrance, the rose is honorably herbal. There are, of course, roses for formal, informal, naturalized and wild areas. Those associated with herb gardens are the old roses with heady fragrance. All the same, herbs are ongoing, and in landscaping I think it reasonable to substitute a suitable modern rose for a rose whose flowering is brief and whose form and foliage fall short of design purpose.

Foliage, above everything else, keys herbs for landscaping. Almost any texture, color, outline and scale one could wish can be found in herbs and almost any degree of airiness and stability. Foliage is happiest when pertinent to its surroundings: purple herb foliage to repeat tree or shrub foliage color, the ferny Sweet Cicely where a fern might grow, or nicely placed gray foliage contrasting with autumn's crimson and gold. Green herbs skillfully handled can

weave carpet or tapestry. Those of non-green and variegated foliage are not new in landscaping, simply in opportunities and combinations that carry out a contemporary mood and idea. Paler greens highlight the deeper greens, perceptibly but without marked contrast. Texture and leaf outline, like color, contrast and accent, increase and diminish and emphasize. It is possible to emphasize the worst in design, but a repeated foliage characteristic sensitively planned is a delight for cohesion and continuity. To foliage one assigns most of the visual impact of herbs in landscaping and much of the design's progression.

Form and foliage interplay. At a distance, form is often one's first visual clue to a plant's identification and thus, indirectly, to the general ecology of the setting and how well a chosen plant fits in. Since herb flowering frequently lacks significance, form and foliage are major components of a focal point with herbs. The more dramatic these are, the more restrained their placing and repetition should be. Otherwise, they overwhelm. Physically, form and foliage may seem to determine the reliability of plant combinations in the competition for air and sun, but it is the root systems in close contact that have the final word.

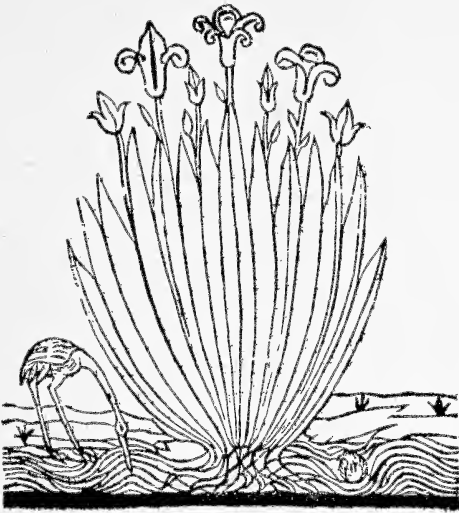
Example: *Lady's Mantle*. Lady's Mantle is a plant unto itself, refusing to mingle casually. One could design with it for foliage, color and flower, but visualizing with it for form is also apt. As a modest accent, it might rest a leaf upon a step and be admired from above for its patterning and fairy tale sparkle of dew; under favorable conditions it has been massed effectively. Singly or not, it stands on its own in all respects.

*Santolina*. Ideal for their foliage color, the santolinas may seem artificial. Their value for form is their being shrub-like accents (*Santolina neapolitana*) and their acceptance of clipping (*S. chamaecyparissus*, *S. virens*). Flowering is attractive when it begins but spoils the quality of the foliage for weeks afterward.

Color is not merely for contrast. In flower, which may not last, and foliage, it widens or shortens distance, heightens or suppresses a curve, compensates in leaf for spent bloom. It upholds design strength across and beyond and emphasizes dimension. Where there is autumn change, there is design change. Color stimulates; it is restful; it balances; and it is a visual bridge.

Examples: *Butterfly Weed*. Exceptionally rich orange flowers are vibrant with blue in the landscape: blue flowers and water and sky. After the blossoms the vertical seedpods are sufficiently interesting to transfer attention to themselves.

*Thymes*. No color in herbs is more engaging than an expanse of Creeping Thyme in flower. Famed in rock gardens, along paths, among steps and flagstones and for garden seats, all hardy thymes offer dainty yet sturdy landscaping material, although they do not forgive a hostile environment. Try a spilling of thyme, starting at the



IRIS. A woodcut from the Latin Herbarius. Vincēciae, Magistrum Leonardum & Guilielmum de Pappia Socios, 1491. The Latin Herbarius is a fifteenth century compilation of classical and Arabian authors based on a manuscript of about 1350. The earliest edition of this work was printed by Peter Schöffer at Mainz in 1484.

top with a golden thyme and darkening down in Caraway Thyme. Fill a knot pattern or an opening left in paving with low thymes of different foliage color and texture. The tallest thymes are delightful small bushes.

*Golden Feverfew.* In a border or in "threes", Golden Feverfew's chartreuse-green foliage has design merit, with or without flowers. It leads the eye to ground level where an underplanting is desired, given enough growing-space and sun. The leaves stay presentable over a long period.

Flowering and fragrance are in some measure expected where there are herbs, and one could do more to plant fragrant and flavorful herbs at enjoying height. In landscaping with herbs, foliage color may supersede flowers, and flowering, flower fragrance. One might prefer to design, for instance, with the sage leaf rather than the flower, and plant hardy lavender for blossoming, with fragrance a bonus. Some herbs are already common because they are popular garden flowers. An herb that is, or resembles, a wild plant, like Beebalm and Borage, seems natural although cultivated. Unfamiliar color, as in White Borage flowers, is noteworthy but not automatically an accent. With herbs in landscaping, one should be wary of fragmenting visual impact with dots and dabs of vivid color. Far-carrying white seems larger in area and affects perspective.

Examples: *Scented Geraniums* (*Pelargoniums*). Such favorites for container and border, wall and terrace, herb gardens and gardens for the blind, might venture further into landscaping, despite their non-hardiness. Theirs is a natural beauty with much variety in form and foliage, scent and flavor. Their unassuming flowers invariably

please. They may need protection from acquisitive visitors.

*Hardy Lavenders.* The grayed tones of some lavenders are valuable for foliage color. Flower interest varies. Lavender is an herb which should be planted in clumps and drifts and low hedges, especially when it has flowers to make a fine display. Few herbs center more pleasure in fragrance. The twisting branches of a gnarled old specimen are picturesque for designing with form.

*Rosemaries.* Herbs without peer in landscaping wherever they are hardy, they have to be grown as temporary plants in cold climates. Tall-growing and bushy rosemaries are wonderful against rock, wall and screen fence and in big containers. Prostrate rosemaries star in window boxes and hanging baskets and wherever they can sprawl gracefully across or down. The entire plant has fragrance and attracts.

Herbs for flavor migrate to the kitchen doorway if not conveniently available elsewhere, but when landscaping, scatter them. The fun of nibbling a spicy leaf while one strolls and weeds is an herb benefit.

Examples: *Mints.* Some mints are eye-catching in form and foliage; almost all have universal appeal because of pleasant flavor memories. Flowers may be attractive, as in Spearmint, or inconspicuous. Link together groupings of openly-spaced, medium height herbs with the random stitchery of Pineapple Mint. Plant velvety Applemint for informal height. Where there is no foot traffic, Corsican Mint might carpet small areas. Controlled by soil barriers and in partial shade, perhaps near a pool or fountain, circles of mint set into white pebbles would cool and entice. For naturalizing on somewhat moist banks by brook and pond, mints are ever among the first plant choices.

*Wintergreen (Gaultheria procumbens).* The close-up is welcome where so much in landscaping focuses on distance. Wintergreen is an herb which has some applicability to natural or naturalized landscaping, and it has leaves to savor. One might reserve it for a partly shaded sitting place. That it is evergreen is an asset; that its flavor refreshes is happy coincidence.

*Wild Marjoram.* Wild Marjoram could enhance a flower garden. In landscaping, its dense, tough rooting establishes it against competition, but it needs sun. Above soft leaves, numerous tiny pink flowers go to seed with continued appeal and an occasional late blossom. Wild Marjoram develops into a drift or ground cover of middle height or a generous patch within a diversified planting. The Golden Marjoram is frequently grown in English gardens.

"Weedy" herbs seem odd to include, but a weed to one person remains a useful herb and plant for another. The weedy herbs might well serve in natural boundary zones, shrubby windbreaks and harsh environments where it is imperative to start things growing. However, avoid the herbs with bad habits: the seriously rampant, like Goutweed; the invasive, like Pokeweed.

Examples: *Tansy*. Admittedly, Tansy is coarse-growing and coarsely aromatic. But Tansy has a rough charm and, expertly grown, creates a thick, informally attractive summer hedge. It seems designed for a meadow fence, on the side away from the field, and to be among wild plants near the sea.

*Comfrey and Elecampane*. Their scale provides a massive foliage accent. In spite of their leaf size, both have flower interest, with honors going to the pink-flowered Comfrey.

*Goldenrod*. Goldenrod turned princess in Europe where it was hybridized for gardens. Dwarf to giant, the goldenrods look well in sunny landscaping if controllable and are not now regarded as a major cause of hayfever. Goldenrod is a seasonally important bee-plant and unforgettable when visited by a migration of monarch butterflies.

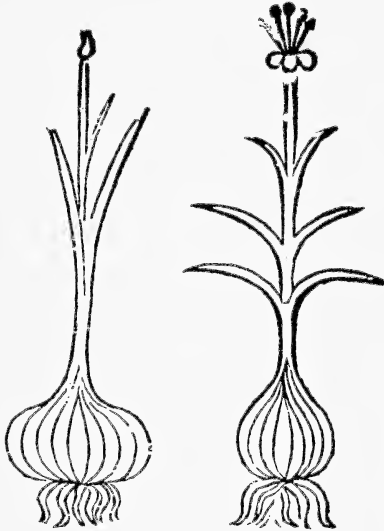
*Joe-Pye-weed*. Nondescript during spring and early summer, it is worth planting for its smoky pinkish-purple flowers which appear July-September. It blooms with goldenrod but is less willing to live in dry conditions. It is for background and natural areas and can be invasive in damp ground. It is not too difficult to control in a maintained landscaping.

Maintenance is only partly a combination of design and what one is willing to invest in cost and effort. If a plant likes the environment it is asked to live in and live with, it grows. Therefore, plant and placing have to agree from the roots up for easiest care and maximum effect if one is to keep any plants in a design. Most herbs like an average, slightly acid soil, some sun, a helpful circulation of air, good year-round drainage, adequate moisture and normal garden care. The safest fertilizers are compost and minerals generally present in bonemeal and seaweed or fish fertilizers. Weak growth is often traced to over-fertilizing, too much water or poor light.

If an herb should do well and doesn't, move it or change its companions. Shield and mulch against excessive sun, and perhaps incorporate stones in mulch or soil for a cooler root-run. Raise a bed and lighten soil for better drainage. To retain moisture, dig in humus suited to the herb's soil preference. Before planting, check the soil for grubs and cutworms, and also install any soil barriers against unwanted spreading. Cutting off dead flowers will prevent rampant self-sowing. To thwart self-layering, prop the lower stems so that they cannot touch ground by installing a wire hoop under them or letting the rim of a soil barrier extend a few inches above the soil. Try to group plants that share special soil and maintenance needs or must have winter covering. Enough cannot be said about forethought and simplifying design to lower cost and upkeep and allow for eventual plant and landscaping maturity.

Once landscaping has been seen, a door opens to one's return. Towards it reach the final herbs, with a last fragrance. After bringing herbs into the house and the garden, landscaping with herbs is

a logical next step. It seems reasonable to forecast that the landscaping of the future will stress economical plant material and maintenance in shrinking space, while contributing to the home and table. Surely herbs will be there for usefulness and beauty, and the older herbs will grow beside herbs now unknown to us. Perhaps we are kinder because herbs were often in kindly human hands over the miles and centuries. Herbs still travel with people; in landscaping, the "ambassadors" to nature, and in our lives, the "supporting".



ALLIUM. *From the Latin Herbarius. The Latin Herbarius is arranged alphabetically, not by any features or characters of the plants it describes.*

### Some Herbs for New England

Deciding which plants are "herbs" and how far to go with varieties is somewhat open to question. An accumulation of lore and tradition parallels usefulness. Flowers bring numerous plants into the category of herbs as bee-plants. Some excuse is found for including an ornamental plant if historically it was grown with herbs in a garden motif. Lists from old herbals and manuscripts persist, and a new group, the wild plants for food, flavor and emergency survival, needs definition. Then there are the plants with centuries of use in household and barn, and for crafts and commerce and religious purposes. As one delves into plant uses, herbal eligibility is never-ending!

With maintenance in mind, I have tried to gather from many sources herbs which contribute visually in a landscape, realizing that someone else's list might be very different. Hardiness further north than Zone 5 is not noted; tenderness is mentioned where sources mention it or it has been experienced. Common sense is needed and so is reasonable expectation, but dare to try a half-hardy herb and a thought for landscaping.

## Key

<b>A</b> — Annual	<b>Po</b> — In some way poisonous
<b>B</b> — Biennial	<b>Q</b> — Acquire the original plant
<b>C</b> — Container growing possible	<b>S</b> — Grow in full sun
<b>C</b> — Container growing best	<b>Sh</b> — Grow in partial shade
<b>H</b> — Named hybrids or clones available	<b>Sh</b> — Grow in shade
<b>N</b> — Native	<b>T</b> — Tender, not hardy
<b>P</b> — Perennial	<b>VI</b> — Visual impact

**I** — For foreground

**II** — For middle ground

**III** — For background

<b>1</b> — Sow seed in spring	<b>4</b> — Start seed indoors
<b>2</b> — Sow seed in autumn, or self-sowing	<b>5</b> — Increase from cuttings
<b>3</b> — Repeat spring-summer sowings	<b>6</b> — Increase by division
	<b>7</b> — Increase from root cuttings
	<b>8</b> — Increase by layering

**Achillea.** Yarrow.

(Compositae)

**H,P,Q,S,2,6.** Suitable for drier locations and poorer soils. Remove spent flowers for best bloom.

*A. argentea.* **I**, to 6 inches. **VI**: carpet; silver foliage.

*A. decolorans.* **II**, to 2 feet. **VI**: clump; white flowers, toothed green leaves. Better soil, adequate moisture.

*A. millefolium.* Common Yarrow. **II**, 1–1½ feet. **VI**: clump; weedy but “the most herbal”. Accepts poor soils.

*A. tomentosa.* Woolly Yarrow. **I**, to 4 inches. **VI**: carpet; silver woolly foliage, yellow flowers.

**Aconitum napellus.** Monkshood.

(Ranunculaceae)

Not recommended. Dangerously poisonous and should be avoided.

**Agastache foeniculum.** Anise Hyssop.

(Labiatae)

**P,S** or **Sh,1,2,6** (spring). **III**, to 4 feet. **VI**: flowers, openly branching form. Fragrant. Late summer violet-pink flowers attractive with perennials. Plant in groups; can be naturalized if controlled. Self-sows readily. Average soil.

**Ajuga.** Bugle, Bugleweed.

(Labiatae)

**H,P,Q,Sh,6** (thinnings). **I**, to 8 inches. **VI**: variety in spring flower color and foliage, foliage the season long. Ground cover; underplanting for taller plants.

*A. genevensis.* Runnerless.

*A. reptans.* Has runners.

**Alchemilla.** Lady's Mantle.

(Rosaceae)

**P,Sh,2,6.** Adequate moisture; avoid very hot conditions.

*A. vulgaris.* **II-III**, to 1½ feet. **VI**: the whole plant; sprays of tiny yellow to yellow-green flowers in June above soft-green fanshaped leaves (var. *mollis* has the best flowers). For accent or contrast, in groups or massed. Remove flower stalk to the ground after blooming.

*A. alpina.* **I**, to 6 inches. Carries the pleated leaf motif to the foreground of the rock garden.

**Allium.** Onion.

(Liliaceae)

**C,H,S,1,2,6.** Many decorative or vegetable garden choices. Average to good



soil. **IMPORTANT:** keep all of these from grazed areas, where they may badly affect the quality of dairy products.

*A. porrum*. Leek. **B. III**, to 4 feet. **VI**: dense round umbels of pinkish flowers in summer; the second year, seed while green; buds look hooded. For accent, in groups. Best in richer soil.

*A. tuberosum*. Garlic Chives. **P. I-II**, to 1½ feet. **VI**: white flowers in summer, flattened leaves. Use in clumps with perennials, or almost anywhere.

*Aloysia triphylla*. Lemon Verbena. (Labiatae)

**C,P,S,T,5. VI**: foliage color. Fragrant. Frequently grown as an annual, though it grows to full shrub size. Seldom flowers out-of-doors in the North.

*Althaea*. Mallow. (Malvaceae)

*A. officinalis*. Marsh Mallow. **P,S,1,5,6. III**, to 6 feet. **VI**: pink summer flowers, soft green foliage; summer shrub stature. A good coastal plant. For naturalizing and as foreground accent group to a vista.

*A. rosea*. Hollyhock. **B,S,1,4. III**, to 6 feet or more. **VI**: height and flowers. Use by house walls, garden walls, and fences; and in old-fashioned settings. Raise new plants yearly. Average garden soils, but will tolerate poor soils.

*Amaranthus hybridus* var. *hypochondriacus*. (Amaranthaceae)

Prince's Feather.

**A,1. III**, to 6 feet. **VI**: summer flowering and height. Weedy, but effective when well placed. Good in poor soils.

*Angelica archangelica*. Angelica. (Umbelliferae)

**B,Sh** or possibly *Sh,2,4. III, to 5 feet (for **II**, treat as an annual). **VI**: foliage; briefly the second year, its flowering and the seeds as they first appear. Do not overcrowd or allow to dry out.*

*Anthemis tinctoria*. Golden Marguerite. (Compositae)

**C,H,P,Q,S,4,6. II-III**, to 3 feet. **VI**: summer flowers. Needs more attention in garden settings than in natural ones. Poor sandy soils.

*Antirrhinum majus*. Snapdragon. (Scrophulariaceae)

**H,P** but may be grown as **A,T,4. II**, 1-2 feet. **VI**: flowers, effectively massed for color. For garden settings, borders, and where the color is set off to its best advantage.

*Arctostaphylos uva-ursi*. Bearberry. (Ericaceae)

**N,P,Q,6,8. I**, to 3 inches. **VI**: the whole plant, year-long. Where it does well, a fine ground cover. Also a mat for rock/wild garden, and useful for naturalizing and rocky slopes. Acid, light, or sandy soils; salt tolerant.

*Arisaema triphyllum*. Jack-in-the-pulpit. (Araceae)

**N,P,Po,Q,Sh** or *Sh,2. I-II-III, to 2½ feet. **VI**: the whole plant, through the summer; brilliant red fruits in autumn. For naturalizing in rich moist woods, openings in shrubbery, and for the wild garden, in groups.*

*Armeria maritima*. Sea Pink, Thrift. (Plumbaginaceae)

**H,P,Q,S,2,6. I**, 3-6 inches. **VI**: the whole plant; pink or white flowers; tufts and carpet. A substitute for mat-forming pinks where these would not do well. For rock gardens, informal edgings, seashore settings as appropriate. Needs good drainage, sandy soil.

*Artemisia*. (Compositae)

Many are weedy and extremely invasive.

*A. abrotanum*. Southernwood. **P,Q,S** or *Sh,5,8. III, to 4 feet. **VI**: summer shrub stature; finely divided gray-green foliage. Aromatic. Good soil and drainage.*

*A. arborescens*. **P,Q,T,5,8. II-III**, to 3 feet. **VI**: worth effort for its silken gray foliage. Very tender, and only for full spring to midsummer.

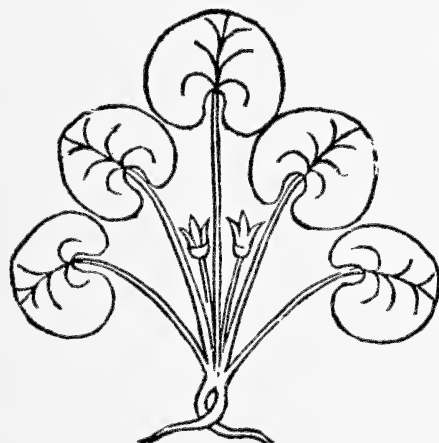
*A. lactiflora*. White Mugwort. **P,Q,S,6. III**, to 5 feet. **VI**: white-cream flowers; green foliage a good background to perennials. Spaced in groups, it is effective in garden and natural settings. Needs adequate moisture, mulch, and good garden soil to bloom well; in poor soil it is weedy.

*A. ludoviciana* var. *albula*. Silver King. **P,Q,S,6. II-III**, to 3 feet. **VI**: drift of silvery fine-leaved foliage; flowers inconspicuous. Try with hybrid goldenrods, achilleas, and near foreground shrubs with good fall color. Requires soil barrier; may need supporting to stay upright.

*A. pontica*. Roman Wormwood. **P,Q,S,6. II-III**, to 3 feet. **VI**: lacy gray-green foliage. Ground cover. Some browning in prolonged humid heat makes it undesirable for foregrounds. In mats in garden/shrub settings.

*A. schmidtiana* 'Silver Mound'. **P,Q,S,6. I-II**, to 1 foot. **VI**: silvery gray-green, feathery mound early in the season. For edgings, borders and accents in garden/rock garden settings. Soil should not be too rich. Cut back part way and water to renew in midsummer.

*A. stellerana*. Beach Wormwood. **N,P,Q,S,6. II**, to 2 feet. **VI**: gray foliage. Only for seashore garden or natural areas.



ASARUM. From the Latin Herbarius. The plants included in the Latin Herbarius are plants native to or cultivated in Germany.

**Asarum. Wild Ginger.**

**(Aristolochiaceae)**

**P,Q,Sh or Sh,2,6,7. I-II**, to 10 inches. **VI**: foliage.

*A. canadense*. Wild Ginger. **N**. Carpet or ground cover, clumps, less formal settings, naturalized areas.

*A. europaeum*. European Wild Ginger. Glossy green foliage. Clump or ground cover; more formal settings. A good accent clump to a rock or ledge background, or by steps and garden structures.

**Asclepias tuberosa. Pleurisy Root, Butterfly Weed.**

**(Asclepiadaceae)**

**P,Q,S,2,7. II-III**, to 3 feet. **VI**: in groups, the whole plant, season-long; especially showy orange summer flowers. Effective in many settings; try it with *Perovskia* and with gray foliage/blue flowers. Light, poor soils.

**Asperula odorata. Sweet Woodruff.**

**(Rubiaceae)**

**P,Q,Sh or Sh,6,8. I**, to 8 inches. **VI**: the whole plant, with starry white flowers in May. As a ground cover, an underplanting to tall shrubs or naturalized in woodlands, it is a favorite. Adequate moisture but good year-

round drainage, and humusy soil. It will not have the best green color if planted in sunny locations. Install soil barrier to 2 inches above soil surface to prevent its creeping into other plants.

***Baptisia australis*. Wild Indigo, False Indigo.** (Leguminosae)

N,P,Q,S or Sh,1,2. II-III, to 4 feet. VI: the whole plant, season long; especially the blue-purple flowers in early summer. For the garden or the wild garden, or naturalized in open areas or on slopes. Has been used as a hedge. Average to good soil, adequate moisture.

***Borago officinalis*. Borage.** (Boraginaceae)

A,S or Sh,1,2. II-III, to 2½ feet. VI: the whole plant; nodding, pink into blue, starry flowers with black anthers cone-like in the center; hairy green leaves and stems. In full sun may be smaller than in light shade. Excellent for temporary plantings at levels permitting full view of the flowers. There is also a white-flowered Borage.

***Calluna vulgaris*. Heather, Ling.** (Ericaceae)

H,P,Q,S,5 (tip), 8. II, shrubby. VI: the whole plant, especially in flower. Best in drifts in sun on slopes where it will have adequate moisture. Also a good specimen plant. Form and flowers vary. Choice of named clones prolongs the blooming period. Good for seashore gardens and landscaping.

***Caltha palustris*. Marsh Marigold.** (Ranunculaceae)

P,Q,S,6. I, to 1 foot. VI: the whole plant; shiny yellow flowers and green leaves in early spring. For bog gardens and naturalizing in swamps and in shallow water of small streams. Disappears in summer.

***Cassia marilandica*. Wild Senna, Midland Senna.** (Leguminosae)

N,P,S or Sh,1,6. III, to 5 feet. VI: of value for midsummer yellow flowers and fall yellow foliage. For sandy or gravelly soils, roadsides and wind-break thickets. Control roots and seeds. Will "landscape" areas difficult to naturalize, but may itself become difficult.

***Celastrus scandens*. Bittersweet.** (Celastraceae)

N. Vigorous woody vine requiring male and female plants to produce its well known yellow and orange-red berries. Should be avoided; it can become complete disaster. May I quote my father? "Your mother wanted a little bittersweet for flower arranging. Now what do we do?"

***Centranthus ruber*. Red Valerian, Jupiter's Beard.** (Valerianaceae)

P,S or Sh,1,6. II-III, to 3 feet. VI: carmine flowers in summer. Not the medicinal Valerian. Here, probably best in garden settings and borders. To control spreading, grow in poor dry soils. Use some lime.

***Cerinthe major*. Wax Flower, Honeywort.** (Boraginaceae)

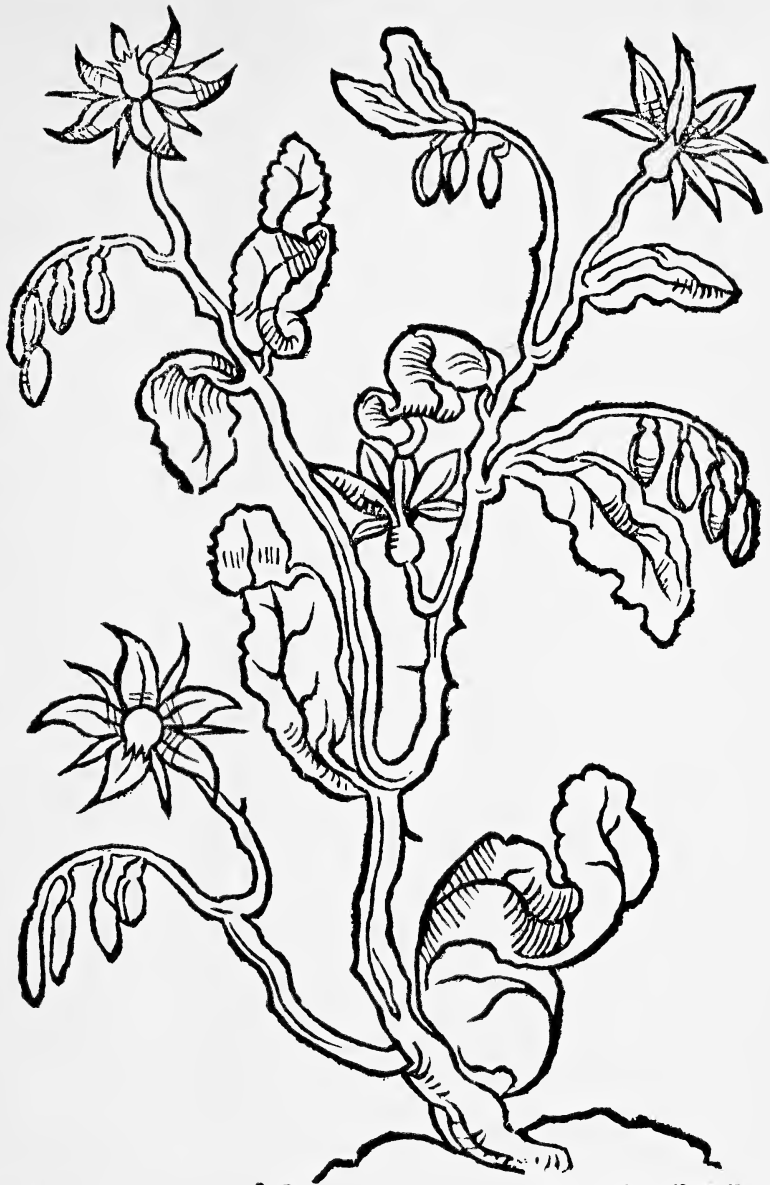
A or B,Sh,1,2. II, to 1 foot. VI: the foliage is a green suggesting coolness; the yellow and brownish flowers recall an old-fashioned chintz. Modest, yet leaf color calls attention to it. Best in limited numbers of groups with annuals and perennials in a foreground to shrubbery. Average soil, adequate moisture.

***Cheiranthus cheiri*. Wallflower, Gillyflower.** (Cruciferae)

B (treat as A), 1. I-II, to 1½ feet. VI: fragrant flowers in a wide choice of warm colors — yellows, reds, bronzes. Worth some effort for special settings and late spring pleasure. Well-drained soil with some lime, adequate moisture, cool climate. It cannot survive a real heat wave.

***Chelone glabra*. White Turtlehead.** (Scrophulariaceae)

N,P,Sh,1,2,6. III, to 3 feet. VI: a single specimen grows to a clump; white to pinkish flowers; foliage for dark green contrast. For the wild garden, or for naturalizing on the banks of streams and ponds. Will accept drier soil if shielded from the hot sun.



**Borago porrich**

**Capitulū·lvj.**

BORAGO. Woodcut from the German Herbarius. Mainz [Peter Schöffer], 1485. The German Herbarius was printed in Mainz a year after the first printing of the Latin Herbarius. It is not a translation of the Latin Herbarius, but largely an independent compilation. Agnes Arber maintains that the woodcuts of the German Herbarius remained the highest achievement of botanical illustration until Brunfels's *Herbarum vivae eicones* (see page 269).

***Chenopodium botrys*. Jerusalem Oak.** (Chenopodiaceae)  
 A,S,1,2. I-II, to 2 feet. VI: of value in groups for arching sprays of densely packed, tiny greenish flowers; seeds prolong the effect. The whole plant is aromatic. Leaves, which resemble those of oak, are slightly bronzed. Good in sandy or gravelly soil.

***Chrysanthemum parthenium* 'Aureum'. Golden Feverfew.** (Compositae)  
 C,P,S or Sh,1,2. I-II, to 2 feet. VI: chartreuse-green decorative foliage, chamomile-like white flower heads with yellow centers. Space or bring together. For garden settings, borders or the foreground partly under tall shrubs in sun. Remove flowers for best foliage. Foliage survives first frost.

***Cimicifuga racemosa*. Black Cohosh, Snakeroot, Bugbane.** (Ranunculaceae)  
 N,P,Sh or Sh,6. III, to 8 feet. VI: flowers, white in long racemes high above pleasing green foliage in summer. For garden settings, the wild garden, naturalizing. Needs a cool, moist, humus-rich soil.

***Cleome spinosa*. Spiderflower.** (Capparaceae)  
 A,H,S,T,1. III, to 3 feet. VI: white to pink flowers. Usually for garden settings, but it can be an accent by itself beside a gate or a corner of a path, or as a plant with others in beds or borders. To me it always seems rather a stranger, but it has long been popular. It has been used successfully in rooftop gardening.

***Convallaria majalis*. Lily-of-the-valley.** (Liliaceae)  
 H,P,Po,Q,Sh or Sh,6. I, to 8 inches. VI: the whole plant. Flowers cherished and fragrant, white (some variants pinkish). One of best underplantings to trees and shrubs. Shady ground cover, but may be invasive. Best in light soils with humus. Remove fruits where children might taste them.

***Delphinium grandiflorum*. Larkspur.** (Ranunculaceae)  
 P,Po,S or Sh,1,6. III, to 4 feet. VI: blue flowers in summer, finely cut foliage. There is a white form.

***Dianthus*. Pink.** (Caryophyllaceae)  
 Just about any fragrant dianthus variety is accepted in herb gardens, especially the perennial, mat-forming pinks. Two of long tradition are:  
*D. barbatus*. Sweet William. B,H,1. I-II. Average garden conditions.  
*D. plumarius*. Cottage or Grass Pink. H,P,Q,1,4,5. II, to 18 inches. Average garden soil.  
 For both, good drainage, not too hot sun, some lime.

***Dicentra spectabilis*. Bleeding Heart, Lyre Flower.** (Fumariaceae)  
 P,Q,Sh,7 (early summer). I-II, to 2 feet. VI: the whole plant for grace and color, especially the arching stalk of pink "hearts". Well known in garden settings, there are places for it in transition zones to shade. It yields interest to other plants quickly when through blooming. Bloom is May-June, and it can be charming with wildflowers. There is a white-flowered form. Moist deep soil but good drainage.

***Digitalis*. Foxglove.** (Scrophulariaceae)  
 Po,Sh,1,2,4. II-III, to 3-4 feet. VI: the flowers, especially in named hybrids. Many settings. Keep from grazed areas if used in naturalizing. For groups and drifts. Adequate moisture.  
*D. purpurea*. B. Pink, purple, or white flowers, often spotted within.  
*D. lutea*. B or P. Soft yellow flowers.

***Dipsacus sylvestris*. Teasel, Brushes and Combs.** (Dipsacaceae)  
 B,S,1. III (second year), to 5 feet. VI: in groups; weedy and prickly but of value for textural contrast, and for seed heads before the seed ripens. Leaves "cup" water around stem. Tolerates poor soil. Sow some seed yearly, selecting for largest seed heads. Should not be permitted to escape.

***Echinops ritro*. Small Globe Thistle, Steel Globe Thistle.** (Compositae)  
**H,P,Q,S,1. III**, to 3 feet or more. **VI**: the whole plant thistly; blue, spiky, round flower heads, before and in full bloom; leaves green above, silvery below. Adequate moisture but good drainage. Remove spent flowers to prolong bloom. May deteriorate in late summer. Background for the perennial border, but fore- or middle ground for such plants as gray *Artemisias*, Tansy, Goldenrod, Elecampane, Comfrey. Clumps.

***Echium vulgare*. Viper's Bugloss.** (Boraginaceae)  
**B,S. II**, to 2½ feet. **VI**: the whole plant. The bristly hairs may cause a skin rash, and it is weedy. But it has some value for dry soils and summer flowers which open pink and become blue. There is a white-flowered form.

***Epilobium angustifolium*. Fireweed, Willow Herb.** (Onagraceae)  
**N,P,Q,S,1,2. III**, to 5 feet or more. **VI**: showy rose-colored flowers (also a white form). Controlled naturalizing, in clearings, fire-desolated areas. Can become invasive, crowding out native wildflowers. Can be transplanted from the wild. **N.B.**: The Willow Herb of swampy ground, *E. hirsutum*, is similar and toxic, and should also be planted with caution. The two species must not be confused.

***Epimedium*. Bishop's Hat, Barrenwort.** (Berberidaceae)  
**P,Q,S or Sh,6. I**, to 1 foot. **VI**: dense foliage, spring flowers. Foreground mat in garden setting or the wild garden, and a fine ground cover under tall shrubs and trees. Adequate moisture. Will tolerate more sun in a richer soil.  
*E. × rubrum*. Red margin to yellowish unfolding leaves.  
*E. grandiflorum*. **H**. Bronze fall color.

***Eryngium*. Eryngo.** (Umbelliferae)  
**P,Q,S,6,7. VI**: the whole plant, for accent; spiky. For dry, poor soil.  
*E. amethystinum*. Amethyst Eryngo. To 1 foot.  
*E. maritimum*. Sea Holly. Light blue flowers, to 1 foot.

***Eupatorium purpureum*. Sweet Joe-Pye-weed.** (Compositae)  
**N,P,S or Sh,1,2,6 (spring only). III**, to about 6 feet. **VI**: smoky-pink flowers in late summer-early fall; somewhat weedy. Fragrant. Of value for its unusual color and season of bloom. Wild garden or naturalized. Possible background plant with perennials. Adequate moisture, open areas.

***Euphorbia marginata*. Snow-on-the-mountain.** (Euphorbiaceae)  
**A,N,Po,1,2. II**, to 2 feet. **VI**: bracts and leaves with white margins. Early to late summer flowering gives it a long season. A plant for showy groups and contrast, chiefly in garden settings. It is somewhat invasive. In spite of its white markings, it is "supporting". It lacks the character of a dominating plant.

***Filipendula vulgaris*. Dropwort.** (Rosaceae)  
**P,Q,S,6. I-II**, to 2 feet. **VI**: fern-like foliage stays low and attractive; creamy-white flowers on long but not fully erect stems. Spent flower stalk should be cut to the ground. With perennials, in rock or wild gardens. The double-flowered form is somewhat smaller. Best in light, dry soils.

***Foeniculum vulgare* var. *dulce*. Common Fennel.** (Umbelliferae)  
**P (treated as A), S,T,1,2. III**, 4-6 feet. **VI**: fine-textured foliage; umbels of small, yellow, late summer flowers. Whole plant is anise-scented. For backgrounds and contrast. There are other varieties of fennel usually only for vegetable gardens.

***Fragaria*. Strawberry.** (Rosaceae)  
**P,Sh,1,2,6. I**, to 8-12 inches. **VI**: the whole plant, season long. For na-

turalizing in carpets; or for garden settings in borders or edgings. Acid soil.

*F. vesca*. European Strawberry. Not reliably hardy, but it self-sows.

*F. virginiana*. Native wild strawberry of rougher pastures, drier soils. For all open areas.

***Gaultheria procumbens*. Wintergreen, Checkerberry.** (Ericaceae)

**N,P,Q,Sh,6. I**, to 6 inches. **VI**: the whole plant, evergreen, but may brown in winter; green to bronzy leaves; dainty whitish flowers and red berries. Can soften the edge of an unset-flagged area in transition to shrubbery or natural wooded areas, and can be a charming mat for a wild garden or limited naturalizing. Acid, open woods; humusy light soil; adequate moisture.

***Hedera helix*. English Ivy.** (Araliaceae)

**C,H,P,Po,Q,Sh,5,8. VI**: clinging vine. Container-grown, it can be trained to resemble topiary. For ground cover. May need some winter protection.

***Helianthus annuus*. Sunflower.** (Compositae)

**A,N,S,1. III**, to 6 feet or more. **VI**: yellow ray flowers, dark purplish-brown disc flowers in late summer. Weedy and coarse, but cheering. For groups with large-scale plants in natural or naturalized areas, or along meadow fences in sun.

***Helleborus niger*. Christmas Rose.** (Ranunculaceae)

**P,Po,Q,Sh,2,6. I**, to 1 foot. **VI**: leathery, evergreen foliage; pinkish and whitish flowers in early spring. This is a plant to have where it can be an accent in bloom but not so prominent the rest of the year. For the wild garden, with shrubs, and for naturalizing. And for pilgrimage. There are other hellebores. This one is always desirable. Needs deep humus-rich soil, some lime, adequate moisture, but good drainage; year round mulch but especially in winter. Where conditions are unsuited, make a permanent raised bed to provide proper soil and soil depth.

***Hemerocallis*. Daylily.** (Liliaceae)

**H,P,Q,S or Sh,6. II-III**, to 1½-3 feet. **VI**: a long flowering season by careful selection. *Hemerocallis fulva* is the orange daylily that spreads and has become naturalized. Various daylilies have had herbal uses here as well as in Japan and China. For garden; massive edging to a path or drive; by door and gate, rock and wall; slopes and transitions in natural and cultivated areas. Some foliage browning after flowering. Needs good soil for best bloom and appearance.

***Hesperis matronalis*. Dame's Rocket, Sweet Rocket.** (Cruciferae)

**H,P (or B?), Sh,1. III**, to 3-4 feet. **VI**: summer flowers in white, mauve or purple on second year plants. There is a double-flowered form. For garden settings and some naturalizing as in transition to shrubbery. Needs good soil.

***Hosta*. Plantain Lily.** (Liliaceae)

**H,P,Q,Sh or Sh (less bloom), 6. II-III**, to 2 feet. **VI**: the whole plant, for foliage accents. *Hosta albo-marginata* has had herbal usage. As clumps or groups in garden settings, with shrubs, as accent by pool or bird bath, along ledge or wall. Try with Solomon Seal. Important in limited landscaping and in transition zones of light and shade. Good soil, adequate moisture.

***Humulus lupulus* 'Aureus'. Golden Hops.** (Cannabaceae)

**P,Q,S or Sh,5 (or by suckers). III. VI**: vine, fast annual growth; hairy golden foliage (which may cause mild, brief skin irritation). Twines readily. Color brings light and contrast or accent and establishes distance.



Good on fences. Dies back in winter. Deep average soil.

**Hypericum.** St.-John's-wort.

(Hypericaceae)

The herbal *H. perforatum* is already an omnipresent weed, and it should not be spread into new areas, but kept for the record under garden control.

**Hyssopus officinalis.** Hyssop.

(Labiatae)

**P,S,1,4,5,6. I-II,** to 1½ feet. **VI:** flowers, shrubby form. A fine plant in garden settings and where color is needed in foregrounds to shrubs; in groups and double-planted for low summer hedging. Average soil, drainage.

*H. officinalis.* Blue flowers.

*H. officinalis* 'Alba'. White flowers.

*H. officinalis* 'Rubra'. Pink flowers.

**Iberis amara.** Candytuft, Rocket.

(Cruciferae)

**A,1. I,** to about 1 foot. **VI:** white flowers. Sow in place. Shear after flowering if used as edging or foreground mat.

**Impatiens balsamina.** Garden Balsam.

(Balsaminaceae)

**A,C,H,1,2,4. I-II,** to 2½ feet. **VI:** foliage a cool green; flowers profuse, cheerful and summer-long; fruits amuse children. Effective when massed, especially in borders, edgings, and window boxes. Flowers are in shades of yellow, white, bright pink, and red. Remove seedlings of undesirable colors.

**Iris.** Iris, Flag.

(Iridaceae)

Tall Iris: **P,Q,S,6. II-III,** to 3 feet. **VI:** foliage; flowers in season. Average garden soil.

*I. × germanica.* Bearded blue.

*I. × germanica* var. *florentina.* White or blue.

*I. pallida.* Bearded pale blue.

*I. pseudacorus.* Yellow Flag. Yellow flowers. For wet soils.

N.B. Do not confuse the Irises with Sweet Flag (*Acorus calamus*), which has an edible rhizome.

**Lamium.** Dead-nettle, Archangel.

(Labiatae)

**H,Sh,P,1,6. I-II.** **VI:** ground cover. Remove flowers for best foliage. Can spread. Limited interest for foreground or mat.

*L. galeobdolon* 'Variegatum' (*Lamiastrum*). Yellow, golden, to 1½ feet.

*L. maculatum* 'Album'. Silver spotted, to 8 inches; lavender flowers.

**Lavandula.** Lavender.

(Labiatae)

There are many varieties, most not hardy. All are for sun, adequate moisture, good drainage.

Two hardy lavenders:

*L. angustifolia* 'Hidcote'. Spreading.

*L. angustifolia* 'Munstead'. Dwarf, upright.

**C,P,Q,S(4),5. II-III.** **VI:** purple flowers, gray foliage. Drifts and clumps, low hedging. Many settings where fragrance would please.

Two non-hardy varieties:

*L. dentata.* **P,Q.** To 2½ feet. **VI:** green leaf. Sparser but longer flowering. Garden settings.

*L. multifida.* **B,Q.** To 2 feet. **VI:** foliage rather than flower. Rock garden.

**Levisticum officinale.** Lovage.

(Umbelliferae)

**P,Q,S or Sh,2,6. III,** to about 6 feet. **VI:** worth some experiments and possibly treatment as an annual; spring foliage like a light bluish-green celery deteriorates with flowering. Needs good soil, adequate moisture. Use fresh seed for best germination.

***Liatris*. Gayfeather.**

(Compositae)

**N,P,S,1,6** (spring). **III**, to 4 feet. **VI**: purple or white flowers which open from top down on long erect spikes from midsummer into autumn. Suited to garden settings, the wild garden and naturalizing, but not in quantities that overwhelm. Will tolerate poor soil.

*L. scariosa*. Tall Gayfeather. Needs adequate moisture and grows in damp open places.

*L. spicata*. Spike Gayfeather. Light soil. The white form can take more moisture and heavier soil.

*L. squarrosa*. To 2 feet. Not so showy.

***Lilium*. Lily.**

(Liliaceae)

**H,P,Q. II-III. VI**: flowers and their height above ground. Visual compensation may be needed after flowering when stem and foliage are left to complete the growing season. General culture: most lilies require sun, excellent drainage but adequate moisture, and a deep, neutral or slightly acid topsoil that is rich in humus. Avoid a fertilizer high in nitrogen and protect from mice and disease-carrying insects. Keep foliage dry when watering. Plant most bulbs 4"-5" deep, making sure that roots and bulbs are healthy and undamaged and the soil properly prepared. Where virus disease and *Botrytis* blight are serious, remove and burn severely infected plants and do not plant again until reasonably safe conditions are established. Hybridizing has given lilies more resistance along with new beauty and importance and a wide choice in form and color. Fragrance still can be a delight.

Some of the lilies with herbal uses are:

*L. auratum*. Goldband Lily. Late summer, 3-6 feet.

*L. canadense*. Canada Lily. Moist ground, July, 2-6 feet. Color varies. Suitable for wild and naturalized areas.

*L. candidum*. Madonna Lily. Late June, 3½ feet. This is the lily of long herbal use and tradition, important in art and religious symbolism. It has travelled far and has been centuries in cultivation. New strains may lessen its unfortunate susceptibility to virus disease and *Botrytis*, and propagating by seed may reduce the spread of virus infection. Plant 1" deep.

*L. martagon*. Martagon Lily. Mid-June, 2-4 feet. Another historic lily.

*L. monadelphum*. Caucasian Lily. Early June, 4 feet. New bulbs may show no signs of growing until their second year.

*L. superbum*. Turkscape Lily. July-August, moist ground and acid soil, 6-10 feet. Suitable for wild and naturalized areas.

***Limonium carolinianum*.**

(Plumbaginaceae)

Sea Lavender, Marsh Rosemary, Statice.

**N,P,Q,S,1. II**, 2-3 feet. **VI**: wiry branching stems of profuse, tiny, pale-lavender flowers above leathery basal leaves. Will tolerate marsh edge and drier soils inland. For naturalizing, rock or wild gardens, seaside areas.

***Linum perenne*. Perennial Flax.**

(Linaceae)

**P,S,1,6** (spring). **I-II**, to 1½ feet. **VI**: plentiful blue or white flowers and delicate appearance. There should be a sufficient number of plants to see them as one approaches them, remembering that individual flowers do not last long and will not open unless there is some sunshine. For garden settings and rock gardens. Good drainage, light winter mulch.

***Lobelia*. Lobelia.**

(Lobeliaceae)

**N,P,S** or **Sh,1,2,6**.

*L. cardinalis*. Cardinal Flower. **II-III**, 2-4 feet. **VI**: scarlet flowers. May be short-lived. Wet soils, stream and pond banks. Erect form combines well with mints where mints lead into moist sites. White form rare.



**LILIUM.** A woodcut from *De historia stirpium*, Leonhard Fuchs. Basle, Isingrin, 1542. Leonhard Fuchs was one of the four "German Fathers of Botany", along with the herbalists Otto Brunfels, Jerome Bock and Valerius Cordus. Fuchs's woodcuts were an achievement even beyond Hans Weiditz's illustrations for Brunfels's *Herbarum vivae eicones* (see page 269), which already marked a considerable departure from the schematic illustrations of the Latin *Herbarius*. Fuchs's accounts of approximately four hundred native German and one hundred foreign plants are arranged alphabetically.

*L. siphilitica*. Blue Cardinal Flower, Great Blue Lobelia. **II-III**, to 3 feet. **VI**: blue flowers. In garden soil with perennials. Groups for effect. There is a white-flowered form also. Will tolerate some wetness and light shade.

*Lonicera periclymenum*. Honeysuckle. (Caprifoliaceae)  
**H,P,Q,S,5,6**. **VI**: climbing vine; strongly scented creamy-white flowers from pinkish buds. For fences and garden structures, possibly over rocks.

*Lupinus perennis*. Sundial Lupine, Wild Lupine. (Leguminosae)  
**P,Po,S** or **Sh,2** (fresh seeds). **VI**: pale lavender-blue spring flowers, divided light-green foliage. Not as showy as modern hybrids but more appropriate for naturalizing or for the wild garden. Slopes, edges of open woods, poor acid soil.

*Lychnis*. Campion, Catchfly. (Caryophyllaceae)  
*L. chalcedonica*. Maltese Cross. **P,S,1**. **II-III**, to 3 feet. **VI**: stiff upright growth, scarlet flowers. With perennials in borders, and possibly some naturalizing. Accenting groups. Summer. Good drainage.  
*L. coronaria*. Rose Campion, Mullein Pink. **B** or **P** (treat as **A**), **S,1,2**. **II-III**, to 3 feet. **VI**: woolly gray foliage. Flowers in summer. Use as above, but will seem more "natural" than Maltese Cross. Good drainage.

*Lysimachia punctata*. Yellow Loosestrife. (Primulaceae)  
**P,Sh,1,6**. **II**, to 2 feet or more. **VI**: mat or carpet of attractive, erect, yellow, early summer flowers. Has a place in a garden setting or naturalized area. Install soil barrier; needs control. Average to moist garden soil.

*Macleaya cordata*. Bocconia, Plume Poppy. (Papaveraceae)  
**P,Q,S,1,6**. **III**, to 8 feet. **VI**: vigorous growth, panicles of creamy flowers in midsummer. Backgrounds, possible summer screening. Install soil barrier.

*Marrubium vulgare*. White Horehound. (Labiatae)  
**P,Q,S** or **Sh,2**. **I-II**, to 2½ feet. **VI**: crinkled, textured, downy, gray-green leaves; downy lighter stems; outward branching form, more or less upright. It can be foreground to erect taller green plants, and has possible use in naturalizing. Average soil. Not always hardy.

*Melissa officinalis*. Lemon Balm. (Labiatae)  
**P,S** or **Sh,1,2,6**. **II-III**, to 2 feet. **VI**: the well-established clump is sizeable; light yellow-green foliage. Cut back to just below last flowers in midsummer and keep watered to renew foliage. Can be treated as annual. Self-sows freely. Where mint might be; some naturalizing. Not too acid soil. Common name is from taste and use of leaves.

*Mentha*. Mint. (Labiatae)  
Many and confusing. Try to obtain a division of a mint that pleases. For variety in foliage, form, and flavor: *M. 'Bowles'*, *M. × gentilis* (golden form), *M. pulegium* (**T**), *M. × rotundifolia*, *M. spicata*. The taller, spreading mints: full sun and adequate moisture for flavor. Soil barrier advisable in garden settings. To thicken old plantings, cut through both ways with a sharp knife when first growth appears in spring.

A quite different mint for special locations:

*M. requienii*. Corsican Mint. **P,Q,T,(2),4,6**. **I**. **VI**: in mats, very small and pungent. Treat as an annual. For foregrounds, rock gardens. Not for foot traffic. Self-sowing unreliable.

*Mitchella repens*. Partridge Berry. (Rubiaceae)  
**P,Q,S** or **Sh,2,5,6**. **I**, to 2 inches. **VI**: whole plant, year-long. Creeping ground cover for woods, wild garden, under small shrubs. Grown in sun in humusy soil with bark mulch, it will be very dense, almost leathery, and

yellow-green. Acid soil. Root the cuttings in Christmas bowls and living wreaths.

**Monarda.** Wild Bergamot, Horse Mint.

(Labiatae)

N,P,Q,S,6.

*M. didyma.* Beebalm, Oswego Tea. III, to 3 feet. VI: summer flowers. For clumps in borders, wild garden, naturalizing. Garden popular (H). May need concealed support halfway. Some moisture, good soil, and air circulation.

*M. fistulosa.* Wild Bergamot. III, to 3 feet. VI: lavender flowers. In drier sunny sites. For naturalizing, the wild garden.

Both attract hummingbirds.

**Myrrhis odorata.** Sweet Cicely, Giant Chervil.

(Umbelliferae)

P,Sh,2,6. II-III, to 3 feet. VI: long-lasting ferny foliage; spreading umbels of white flowers in early summer, followed by interesting seeds. If not saving seed, remove flower stalk to ground after bloom. Whole plant has anise fragrance. For garden settings; by walls; naturalizing in humusy, moist soils or an alternative to larger ferns in clumps. Also, a decorative foreground, for planting with shrubs having colored foliage, or as a background for *Vinca* in permanent landscaping. Allow space — Sweet Cicely becomes a substantial clump. Adequate moisture.

**Nepeta.** Catmint.

(Labiatae)

N.  $\times$  *faassenii*. Persian Catmint. P,Q,S,V,1,2. I-II, to 1½ feet. VI: gray-green foliage, lavender-blue flowers. For best foliage and continuing bloom, remove spent flowers. For garden settings, borders, drifts, or ground cover. Summer. Plants in groups. Try a "three" of *Perovskia*, *Artemisia* 'Silver Mound', and N.  $\times$  *faassenii*.

*N. grandiflora.* Caucasian Nepeta. Plant in groups. Accepts some clipping. Mauve flowers. Borders of perennials.

*N. hederacea* (*Glechoma hederacea*). Gill-over-the-ground, Ground Ivy.

P,Q,S or Sh,2. VI: a weed but decorative, and of some value for its low creeping cover. It enters garden and landscaping here and there. Summer. Poor soil helps to control.

**Nigella damascena.** Love-in-a-mist, Fennelflower.

(Ranunculaceae)

A,H,S,1,2. I-II, to 2 feet. VI: airy form, delightful summer flowers, and puffed-up seed pods. Mixed shades in flower color — pinks, blues, white — but a short season. Garden settings and borders, and to fill in or be "supporting".

**Nymphaea odorata.** Fragrant Water Lily.

(Nymphaeaceae)

N,P,Q,6. VI: lily pads and fragrant white to pale pink flowers. Quiet water to about 2 feet deep. Weight down roots when planting. For pools, plant in tubs and sink in place. Summer flowering. Invasive.

**Oenothera biennis.** Evening Primrose.

(Onagraceae)

B,S,1,2. III, to 4 feet. VI: weedy by day; plant a group where early evening flowers can be watched as they open in summer. Flowers have four broad, yellow petals. Select seed for largest flowers.

**Origanum.** Marjoram.

(Labiatae)

*O. majorana.* Sweet Marjoram, Knotted Marjoram. C,P (treat as A), Q,4. II, to 1½ feet. VI: soft gray-green foliage, small white flowers "boxed" by green bracts. Late summer. Shrubby and fragrant. A gentle plant to be supporting for a "three". Garden settings. Average soil. Not hardy.

*O. vulgare.* Wild Marjoram or Pot Marjoram. P,Q,S,2,6. II-III, to about 2 feet. VI: whole plant; especially the pink flowers, and, when going to seed, the red-tinged bracts. Dense mat, clumps, patches; garden settings



PAEONIA. A copperplate engraving from *Hortus floridus*, Crispijn vande Pas the Younger. Arnheim, J. Janson, 1614. Crispijn vande Pas's *Hortus floridus* closes the great period of illustrated herbals. With the scientific advances in botany during the seventeenth century the herbal gives way to medical pharmacopeia and botanical floras. Crispijn vande Pas divides the first half of his book into four parts for the seasons of the year, the peony shown here beginning the second part, summer.

and beyond. Good drainage. Try Pot Marjoram in landscaping with low-spreading evergreens such as juniper.

O. 'Aureum'. Golden Marjoram. VI: foliage. May not be reliably hardy. Popular in English gardens.

**Paeonia. Peony.**

(Paeoniaceae)

H,P,Q,S or Sh,6. II-III. VI: flowers, but foliage holds its own. Large in scale. Garden settings.

*P. lactiflora*. Chinese Peony. To 3½ feet.

*P. officinalis*. To 3 feet.

*P. suffruticosa*. Tree Peony. To 4 feet or more.

**Panax quinquefolius. American Ginseng.**

(Araliaceae)

N,P,Sh,1,2. II, to 1½ feet. VI: whole plant, especially foliage, for carpet. Some value in shady gardens. For naturalizing. Rich woods, acid soil, adequate moisture.

**Parthenocissus quinquefolia. Woodbine, Virginia Creeper.**

(Vitaceae)

N,P,Q,S or Sh,1,8. VI: all seasons, especially fall berries and red foliage. Clinging, woody, rambling vine. Garden settings, or for naturalizing if controlled. Attractive foliage season-long.

**Pelargonium. Scented Geranium.**

(Geraniaceae)

C,C,H,P,Q,S,T,5. VI: form, foliage; flowers less important. Fragrant (may mimic other scents). Average garden soil.

Ten herbal choices, the basic ten of Susan W. Handy, past President and Medal of Honor, The Herb Society of America:

To 20 inches:

*P. × citrosum* 'Prince of Orange'. Orange scent.

*P. × fragrans*. Nutmeg scent.

*P. graveolens* 'Minor'. Little-leaf Rose Geranium.

*P. × nervosum*. Lime scent.

*P. tomentosum*. Small-leaved Peppermint Geranium. Peppermint scent.

To 40 inches:

*P. crispum* 'Prince Rupert'. Finger Bowl Geranium, probably from its use (also a variegated form).

*P. denticulatum* 'Dr. Livingston'. Skeleton-leaf Rose Geranium.

*P. graveolens*. Large-leaved Rose Geranium.

*P. quercifolium* 'Pinnatifidum'. Sharp-toothed Oak-leaf Geranium.

*P. tomentosum* 'Clorinda'. Large-leaved Peppermint Geranium. Flowers well.

**Perilla frutescens 'Crispa'. Purple Perilla.**

(Labiatae)

A,C,S,1,2 (self-sows freely). II-III, to about 2 feet. VI: wonderful, dark purple-red, crinkly foliage, green-tinged by season's end; pink, half-hidden flowers. More enduring than 'Dark Opal' Basil, more "natural" in local settings. In groups for accent or contrast. Aromatic, insect-resistant.

**Perovskia abrotanoides. Perovskia.**

(Labiatae)

P,Q,S,5,6. III, to 4 feet. VI: whole plant; semi-shrub with silvery stems, light gray-green foliage; long-lasting lavender-blue flowers in July-August. Fragrant. Always leave several buds when cutting back in fall, and allow time to start new growth in spring. Its roots spread, making a sizeable but also controllable clump. Excellent for garden settings and in sunny foreground to shrubbery. By steps and terrace. For the latter, plant at same point on levels above and below for "flow" of bloom. Average soil, mulch. *Perovskia atriplicifolia* is similar but leaves are not so pretty.

**Petroselinum crispum. Parsley.**

(Umbelliferae)

B (best treated as A), C,H,1. I-II, to over 1 foot. VI: foliage the first year.



Can be allowed to self-sow the second year. Planted closely in good soil, it is worth experiments in blocks and groups, rather than just as edging. In containers for itself, or as contrast to other plants.

***Phytolacca americana.***

(Phytolaccaceae)

Poke, Virginia Poke, Native Pokeweed.

N,P,Po. I-III, to about 4 feet. VI: coarse, weedy, erect; purple fall fruit. Invasive, can be toxic especially when older; I wonder why it is listed for gardens. One to avoid.

***Platycodon grandiflorus.*** Balloon Flower.

(Campanulaceae)

P,Q,4. II-III, to about 2½ feet. VI: the whole plant; glaucous stems and foliage, interesting buds and fresh seed pods, blue summer flowers. Borders, garden settings, in groups. May need staking. Well-drained soil.

***Podophyllum peltatum.*** May Apple.

(Berberidaceae)

P,Po,Q,Sh,2,6. II, to 1½ feet. VI: the whole plant. For shady gardens or naturalizing, in patches and as ground cover. If a glimpse of fruits and flowers is wanted, plant at height for seeing these on terrace or slope. Open woods, humusy soil, adequate moisture.

***Polemonium caeruleum.*** Jacob's Ladder, Greek Valerian. (Polemoniaceae)

P,Sh,1,6. II, to about 2 feet. (For I also, as a possible contrast.) VI: blue spring and early summer flowers, foliage. In garden settings and soils.

***Polygonatum biflorum.*** Solomon's Seal.

(Liliaceae)

N,P,Q,Sh,2,6 (in spring). I,II,III, to 2 feet. VI: the whole plant, especially the foliage on arching stems; pendent spring flowers. Shady gardens, woods, thickets, slopes. Where everyone would like it; a graceful plant excellent for wild garden and naturalizing. Slightly acid soil. There are other herbal types. This is a good one for a start.

***Pulmonaria.*** Lungwort.

(Boraginaceae)

*P. angustifolia.* P,Q,Sh,6. I, to 6 inches or more. VI: very early spring flowers, dark pink into bright blue above and with plain green foliage. For foregrounds, borders, garden or wild garden, drifts and blocks, ground cover, edging. Blue Grape Hyacinth is pretty with it in spring. Adequate moisture, especially in hot dry spells.

*P. officinalis* and *P. saccharata.* Bethlehem Sage. (H). I,II,III, to 1½ feet. VI: spotted foliage, whitish on green. Later spring flowering. Clumps, in garden settings, wild or rock gardens. Can be an accent (early season when at peak), is always a contrast. Needs shielding from sun and watering at first sign of drying out, or foliage browns.

***Pycnanthemum pilosum.*** Mountain Mint.

(Labiatae)

P,Sh,1,6. III, to 4 feet. VI: foliage. For naturalizing and wild gardens, but also for borders and places where its clump of foliage adds to landscaping. Some interest in its late summer flowers has brought it among garden flowers.

***Reseda odorata.*** Mignonette.

(Resedaceae)

A,H,S,1. I-II, to 1½ feet. VI: the whole plant, especially the flowers. Fragrant and "supporting", in form and flower color. Add some lime if the soil is acid.

***Rheum raphaniticum.*** Rhubarb.

(Polygonaceae)

H,P,Po,Q,S,6. III. VI: weedy but of value where its massive foliage and form are wanted in design. Leaves (not leaf stalk) poisonous. Not the usual medicinal rhubarb, but herbally used as well as being a popular food. Try 'Valentine' for cleanly-separating rosy leaf stalks. Rich soil.

**Rosa. Rose.**

(Rosaceae)

**H,P,Q,S,5** (seeds, experimentally). **VI:** flowers, especially pink or red, and form. All are fragrant. The older roses are of greatest interest for history and use. Many newer roses are descended from them. The following are best planted in good soil; they need space and bloom once in midsummer unless otherwise noted:

*R. centifolia*. Cabbage Rose. To 6'. Very large, round pink flowers with hollow centers. The Moss Rose so popular in Victorian times is *R. centifolia* 'Muscosa'.

*R. damascena*. Damask Rose. To 6'. The rose famous in attar of roses. Similar to *R. gallica*, its flowers are slightly later and smaller. The York and Lancaster Rose is *R. damascena* 'Versicolor'.

*R. eglanteria*. Sweet Brier, Eglantine. To 8' or more. Single, earlier pink flowers, arching form; foliage also scented; colorful hips. For fences and windbreak hedging.

*R. gallica*. French Rose. To 4'. Much loved is *R. gallica* 'Versicolor' — Rosa Mundi.

*R. rubrifolia*. Redleaf Rose. To 6'. Longer in bloom; small single pink flowers in clusters, decorative hips. Foliage and stems offer color contrast.

One should also mention the Rugosa Roses, increasingly sold for public and private landscaping, hedges and plantings by the sea. Many have good fruits for preserves and syrups and some value for fall foliage color. My favorites are: 'Frau Dagmar Hastrup', to 4'-5', silken, single pale pink flowers; and 'Schneezweig', to 5'-6', semi-double white flowers all season.

**Ruta graveolens. Common Rue, Herb of Grace.**

(Rutaceae)

**H,P,Po,Q,S,1,4,6. II-III**, to 3 feet. **VI:** summer shrub stature, decorative glaucous foliage, yellowish summer flowers. Never in foreground in public places because the foliage can cause a painful skin rash. May die back in winter. Chiefly for garden settings, singly or in small groups. Spectacular with *Thymus praecox* 'Coccineus', Crimson Thyme, in flower. There are variants for bluer foliage, also a white-variegated one. Good drainage.

**Salvia. Sage.**

(Labiatae)

A large genus herbally, and one to assess for herbal vs. merely ornamental uses. In general, the variegated seem non-hardy.

*S. argentea*. Silver Sage. **B.** Very woolly and silky. First year, low and decorative. Weedy when it flowers.

*S. azurea*. **P.** Popular garden perennial, light blue flowers.

*S. farinacea*. **H,P** (A where not hardy). Grayish foliage, blue flowers, in gardens.

*S. lyrata*. Lyre-leaved Sage. **N.** Wild garden or naturalizing.

*S. clevelandii*. Cleveland Sage. **N,T.** Shrubby, very aromatic.

*S. officinalis*. Garden Sage. All forms. Sub-shrub, excellent for many settings and with perennials.

*S. rutilans*. Pineapple Sage. **T.** Red-flowered, large, bushy.

*S. sclarea*. Clary. **B.** Self-sows. For its flowers and bracts.

N.B.: "Jerusalem Sage" is *Phlomis fruticosa*.

**Sanguinaria canadensis. Bloodroot.**

(Papaveraceae)

**N,P,Po,Q,Sh,6** (only after leaves disappear in fall). **VI:** early white flowers and light-green lobed leaves. There are single and double-flowered forms. The double-flowered bloodroot is exquisite; the single will self-sow. Bark mulch in sunnier locations in garden settings. Wild or rock gardens; naturalizing in woods. Cool humusy soil.

**Santolina. Lavender Cotton.**

(Compositae)

**C,P,Q,S,5,8. VI:** foliage. Remove flowers for best foliage. Replace as needed

when old. Edgings, garden settings, accent, contrast, patterns. Good drainage.

*S. chamaecyparissus*, *S. chamaecyparissus* 'Nana'. **I-II**, to 2 feet. Accept clipping. Compact gray-white foliage.

*S. neapolitana*. **II-III**. Feathery gray-green foliage, summer shrub stature.

*S. virens*. **I-II**. Small summer shrub stature, 1-2 feet. Green foliage. Not reliably hardy.

***Saponaria officinalis*. Bouncing Bet, Soapwort. (Caryophyllaceae)**

**P,Q,1,2,6. II**, to 2½ feet. **VI**: erect clumps, pretty light-pink flowers. On the fringes of "weed", but where it can be controlled, for some garden settings, wild garden, or naturalizing.

***Satureja montana*. Winter Savory.**

**(Labiatae)**

**P,Q,S,8. I-II**, to 1 foot. **VI**: whole plant, somewhat woody; graceful semi-erect form; neat green foliage; flowers small, profuse, white to pinkish in mid- to late-summer. Foreground in border, perhaps middle ground in rock garden. Accepts trimming but not formal clipping. An appealing herb season-long. Light winter covering helps. Average soil, drainage. "Ambassador" to and from thymes.

***Sedum*. Stonecrop.**

**(Crassulaceae)**

**H,P,Q,S,6**. Garden settings, rock garden. Good drainage. Herbal species: Tall:

*S. orpine*. **H**. To 18 inches.

Low:

*S. telephium*. Flowers coppery, rusty.

*S. acre*. Gold Moss. To 2 inches. Yellow flowers.

*S. anglicum*. English Sedum. To 2 inches. White flowers, evergreen.

*S. sexangulare*. Hexagon Stonecrop. To 3 inches. Yellow flowers, evergreen.

***Sempervivum tectorum*. Houseleek, Hen-and-chickens.**

**(Crassulaceae)**

**P,S,1,6 (C in sink or dish gardens). I**, to 4 inches. **VI**: low closely packed rosettes of fleshy leaves, pinkish-red flowers on thick stems. Familiar yet exotic. Rock gardens, crevices, stony foregrounds.

***Senecio cineraria* (*Cineraria maritima*). Dusty Miller.**

**(Compositae)**

**H,P,S,1,4. I-II-III. VI**: white, very downy foliage. For garden settings, but as an accent anywhere. For Beach Dusty Miller or Wormwood see *Artemisia stellerana*.

***Silybum marianum*. Blessed Milk Thistle.**

**(Compositae)**

**A,S,1. III**, to 4 feet. **VI**: glossy, spiny-toothed leaves spotted with white; rose-purple flower heads. Thistle-like, tall-growing. Accent and contrast. Average soil.

***Solidago*. Goldenrod.**

**(Compositae)**

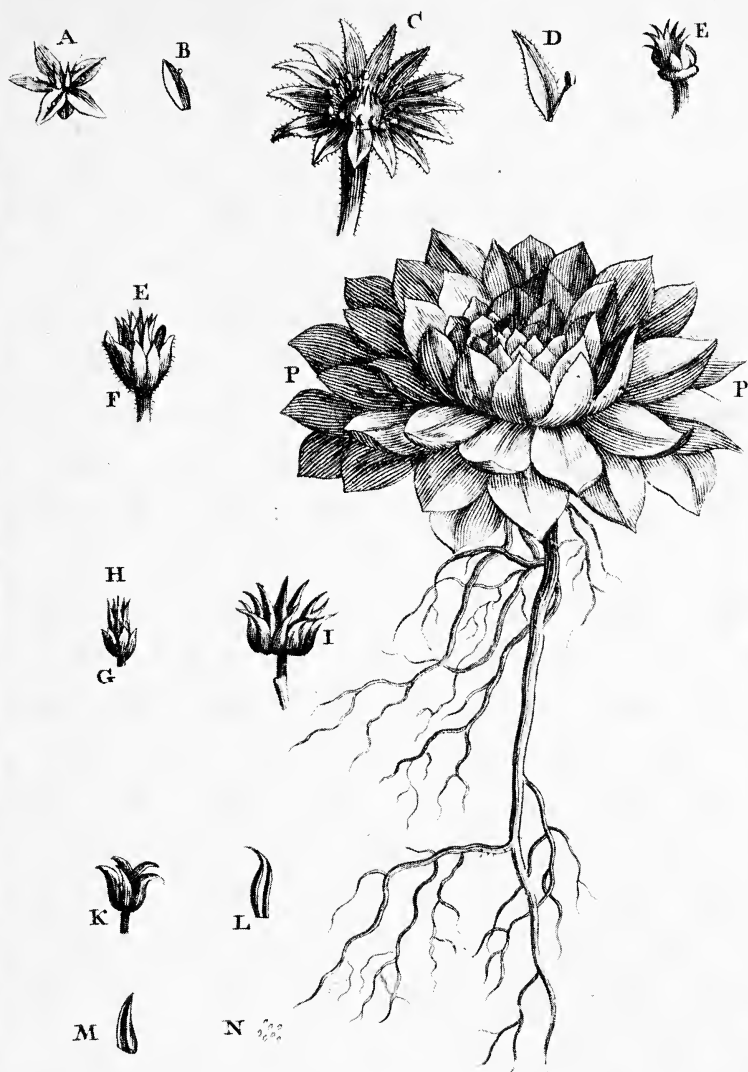
**N,P,S,6**. Many wild and naturally hybridized varieties of differing height and form can be found. A number of wild goldenrods have had Indian herbal uses. Some are still used as dye herbs. Very invasive; their growing should be well controlled. (**H**).

*S. odorata*. To 4 feet. Plumed. The anise-scented Sweet Goldenrod of the Shakers.

***Stachys*. Betony.**

**(Labiatae)**

*S. grandiflora*, *S. macrantha*. Big Betony. **P,Q,Sh,1,2. II-III**, to 2½ feet. **VI**: the whole plant; wrinkled, heart-shaped, green foliage; reddish-purple flowers. In garden settings but also in the wild garden and for transitions from drier soils to moister soil naturalizing, as with mints. Average soil, drainage.



SEMPERVIVUM (as SEDUM). A copperplate engraving from *The Compleat Herbal*, a translation by John Martyn of *Institutiones Rei Herbariae*, Joseph Pitton de Tournefort. London, R. Bonwicke, Tm. Goodwin, et al., 1719. Tournefort's plates, with their morphological detail drawings surrounding views of the whole plant, reflect the transition to scientifically oriented treatises that takes place during the seventeenth century.

*S. olympica*. Lamb's Ears, God's Carpet, Woolly Betony. **P,Q,S,1,6. I**, low if not allowed to flower, or to 12 inches. **VI**: few plants are more delightfully velvety; foliage silky gray-green. Foreground, garden settings and rock garden, edging, ground cover in special places. Magenta-pink flowers should be removed for best foliage. 'Silver Carpet' does not flower. Bark mulch for first plants; good drainage.

*Symphytum officinale*. Comfrey, Knitbone. (Boraginaceae)  
**P,Q,Sh,1,4,6. III**, to 3 feet. **VI**: foliage, for scale and mass; whitish to purple flowers are pretty but secondary in effect. Dig out old clumps.

*Tanacetum vulgare* var. *crispum*. Tansy. (Compositae)  
**P,Po,Q,S,2,6. III**, to 3 feet. **VI**: natural settings; late-summer yellow flowering. Use only if invasiveness can be controlled. Now considered toxic for culinary use, but has other uses. Poor soils.  
*T. huronense*. Woolly and weedier.

*Teucrium*. Germander. (Labiatae)  
*T. canadense*. Wild Germander, Wood Sage. **N,P,Q,Sh,1,5,6. I-II**, 8 inches to 3 feet. **VI**: pink flowers, narrow to broad leaves. Seen planted in blocks as ground cover, but possibly best naturalized.

*T. chamaedrys*. **P,Q,S,5,8** (early spring, self-layering of plant's lowest growth). **I**, to 10 inches. **VI**: glossy rich green leaves, woody upright growth, magenta-pink flowers on erect stems above leaves. Light winter covering. Border groups, edgings, patterns. Accepts clipping. For plant strength, do not clip after August 1st. Remove flowers for best foliage. Average soil, mulch.

*T. fruticans*. **C,P,Q,T,5. VI**: summer shrub, branching; flat gray-blue flowers, gray-green foliage. Clipped for ornamental hedging.

*Thymus*. Thyme. (Labiatae)  
**P,Q,S**. Every thyme is one to try, and a bee-plant if nothing else. Form, foliage, and flower differ. Propagate by cutting, division, or layering, because seed may not come true. Light winter cover in the garden, light soil, good year-round drainage.

Three outstanding culinary thymes:

*T. × citriodorus*. Lemon Thyme.

*T. herba-barona*. Caraway Thyme.

*T. vulgaris*. Common or Culinary Thyme. There are French and English variants; the French has a finer leaf.

For the garden, Lemon and Common Thyme offer variegated silver and golden forms and/or silver-leaf margin forms. In general the silver thymes are not hardy. For the garden, start with *T. praecox* subsp. *arcticus*, or *T. serpyllum*, Mother-of-thyme, which has many variants. For texture, *T. pseudolanuginosus*, gray, woolly, flat-creeping, or *T. thracicus*, to 4 inches, creeping, with woolly stems.

A thyme "belongs" with a sundial. There is a place for thymes in many garden and landscaping designs: pavings, stepping stones, banks, blocks, seats, edges of paths, fillings of patterns, and so on. Learn what each offers and its limitations. Many are not hardy.

*Tiarella cordifolia*. Foam Flower. (Saxifragaceae)  
**N,P,Q,Sh,1,2,6. II**, to 1 foot. **VI**: in spring, foamy white flowers prove its name. Dense broad green leaves make fine ground cover or carpet for shady garden or wild garden, or naturalized in woods and under deciduous trees. Rich humusy soil, moderately acid to neutral.

*Trollius europaeus*. Globeflower. (Ranunculaceae)  
**H,P,S** or **Sh,2,6. I-II**, to 2 feet. **VI**: rounded yellow flowers on erect stems above deeply cut foliage. An accent in flower, from late spring to early

summer. Adequate moisture, even somewhat moist areas; average soil.

***Tropaeolum. Nasturtium.***

(**Tropaeolaceae**)

A,C,S,I. VI: the whole plant; variety in flowers. Informal settings, garden and beyond. Changes of level. Summer. Tolerant if soil is light and neutral.

*T. majus.* To 6 feet. Climbing, supported or allowed to trail.

*T. minus.* Dwarf, bushy.

***Verbascum thapsus.* Mullein, Herbe de St. Fiacre.**

(**Scrophulariaceae**)

B,S,I,2. III, to 3 feet or more. VI: first year, low, very woolly, felt-like gray-green leaves; second year, yellow flowers atop a tall, sturdy leaf stem. Of value for naturalizing or for rather difficult natural areas. The hybrid garden varieties overshadow the Common Mullein, but it has its own appeal. Somewhat weedy. Dry soils.

***Vinca. Periwinkle, Sorcerer's Violet.***

(**Apocynaceae**)

C,H,P,Q,Sh,6. I. VI: fine ground cover with blue or white flowers. With shrubs and in blocks and strips, as well as ground cover carpet. Versatile and spreading.

*V. major.* Larger.

*V. minor.* Smaller.

***Vitis. Grape Vine.***

(**Vitaceae**)

H,Q,5, air-layering. One of the few good vines with herbal uses. Many varieties are cultivated.

*V. labrusca.* Wild or Fox Grape. Invasive.

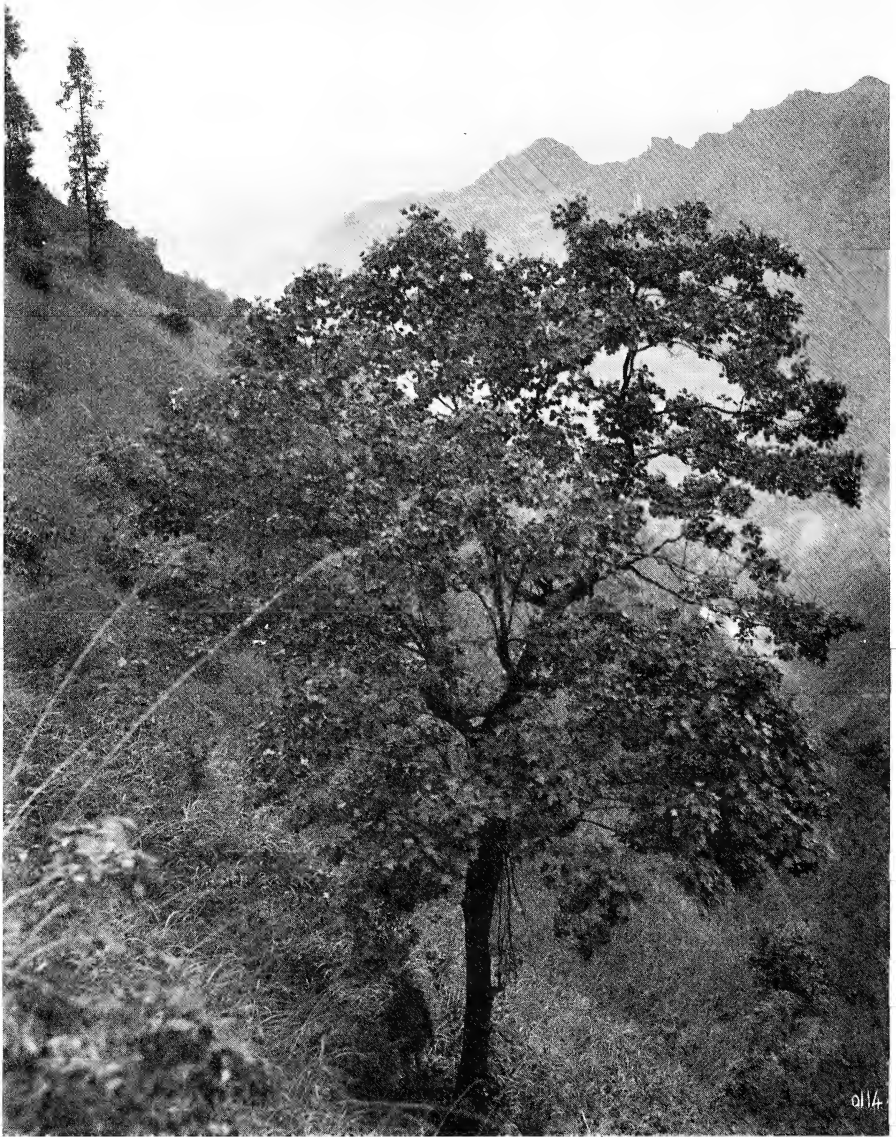
***Yucca filamentosa.* Adam's Needle.**

(**Liliaceae**)

H,P,S,I,6. III, foliage to 3 feet, flower stalk to 8 feet. VI: whole plant, for accent and a hint of faraway places once visited. In landscape and old-fashioned garden. Deep-rooting. Handsome creamy summer flowers. Tolerates poor or sandy soils.



ARBUSTA VARIA. A woodcut from *Herbarum vivae eicones*, Otto Brunfels. Strasbourg, Johann Schott, 1530.



A 60-foot-tall specimen of *Liriodendron chinense* photographed near Patung Hsien, China, by E. H. Wilson on his third expedition for the Arnold Arboretum in June 1910. The species is the Chinese counterpart of our native Tulip Tree, *L. tulipifera*, and is in fact the only other member of the genus *Liriodendron*. It was introduced into cultivation by Wilson when he was employed by the British firm of Veitch and Son. *Liriodendron* is a fine example of the close relationship between the floras of China and the eastern United States. Unfortunately we cannot compare living examples of the two species here at the Arnold Arboretum because *L. chinense* is not hardy this far north.



# Introduction of North American Trees into China

## *A brief summary*

by C. K. SHENG

In developing their own agricultural, silvicultural and horticultural enterprises, the Chinese people have made a great effort to introduce economic and garden plants from foreign countries since very remote times. Plant introduction not only has enriched Chinese plant resources and bettered livelihood and social economy, but it also is a beautiful chapter in the history of the mutual exchange of friendship and civilization between the peoples of China and of other countries.

In spite of the fact that China is one of the centers of diversity of cultivated plants, the uneven distribution and geographic isolation of plants in the world has compelled the Chinese people to explore for and introduce plants they wanted from abroad.

The vast territory, the complicated climatic and edaphic conditions, and the diversity of agricultural practices in China afford a great possibility for plant introduction and acclimatization. For a thousand years, but especially after the founding of the People's Republic, the Chinese people have greatly benefited from their efforts in the collection of useful plants not indigenous to their country.

After the discovery of the New World, North American plants, es-

*Professor Sheng was a member of a delegation of botanists from the People's Republic of China which visited the Arnold Arboretum in early May of 1979. We are honored to present this article of his to the readers of Arnoldia. Present address: Botanic Garden of Nanking, Institute of Botany, Kiangsu, People's Republic of China.*

pecially those from the United States of America, became new settlers in China via different channels, and in no lesser way Chinese plants became immigrants to the New World through enthusiastic American plant hunters.

To summarize the whole story of the introduction of American plants into China would be a rather tedious task, and even the present discussion of the introduction of woody plants can by no means be given in great detail.

The introduction of North American trees into China has a history of about one hundred years. By the end of the last century sporadic introduction was carried on here and there by some Chinese nurseries and garden amateurs, as well as by American citizens and diplomats in China. *Robinia pseudoacacia*, *Carya illinoensis*, *Juglans nigra*, *Taxodium distichum*, *T. ascendens*, *Ulmus americana*, and *Catalpa speciosa* were the forerunners.

During the thirties of this century conditions improved for plant introduction, although only two botanic gardens were then established: those at Nanking and Lushan. North American conifers such as *Pinus elliottii*, *P. taeda*, *P. palustris*, *P. echinata*, *P. rigida*, *Cupressus arizonica*, and *Thuja occidentalis*, and broad-leaved trees such as *Platanus occidentalis*, *Liriodendron tulipifera*, and *Magnolia grandiflora* were the newcomers which adorned the Chinese landscape and campus in the coastal cities of the subtropical provinces in eastern China. Meanwhile, interest in introducing Chinese trees was greatly promoted on the American continent. It is worth mentioning Professors R. W. Chaney and E. D. Merrill, as a result of whose extreme interest in Chinese plants the first package of seeds of *Metasequoia* was sent from Nanking in December 1947, arriving at the Arnold Arboretum on January 5, 1948.

After the founding of the People's Republic, the introduction of North American trees into China was put on the right trail for the first time. More botanic gardens were established in the various provinces and districts, and these acted as trial grounds for tree introduction. Among the fifteen exotic coniferous trees on the official introduction list, the following thirteen are North American species:

<i>Cupressus arizonica</i>	<i>Pseudotaxus menziesii</i> var. <i>glauca</i>
<i>Pinus elliottii</i>	<i>P. menziesii</i> var. <i>viridis</i>
<i>P. taeda</i>	<i>Taxodium ascendens</i>
<i>P. caribaea</i>	<i>T. distichum</i>
<i>P. strobus</i>	<i>Sequoia sempervirens</i>
<i>P. serotina</i>	<i>Sequoiadendron giganteum</i>
<i>P. palustris</i>	

## Growth of some North American trees in China

## CONIFERS

*Pinus*: About twenty species of North American pines have been introduced. They may be grouped into three categories according to their degree of adaptability after introduction.

1. Promising species, extensively planted in the Yangtze and Pearl River Valleys — *Pinus elliottii*, *P. taeda*, *P. palustris*, *P. caribaea*, *P. serotina*, etc.
2. Growth normal, but not yet to the stage for commercial planting — *Pinus echinata*, *P. ponderosa*, *P. strobus*, *P. rigida*, etc.
3. Species with uncertain possibilities — *Pinus banksiana*, *P. leiophylla*, *P. jeffreyi*, etc.

Among *Pinus* species, *P. elliottii* and *P. taeda* have been fast growing in the district of Nanking. They both produce new shoots three to four times during the growing season. Their straight boles and almost complete immunity to the infection of *Dendrolimus punctatum* and *Matsucoccus matsumurae*, which threatened the growth of *P. massoniana*, have made them valuable timber trees. The resin yield of the adult tree of *P. taeda* in Kwangsi is 50% higher than that of *P. massoniana*. But sporogenesis and the development of the young cone of *P. elliottii* are handicapped by low spring temperatures in the district of Nanking, while the fertility of the hardier *P. taeda* reaches 60–70%.

TABLE 1. GROWTH OF AMERICAN SPECIES OF *Pinus*.

Species	Years of introduction	Growth			Locality	Fertility
		Height (m.)	DBH (cm.)	Age (yrs.)		
<i>Pinus elliottii</i>	1930, 1947, 1973	12.2	20.8	22	Nanking	10%
		16.5	36.0	31	Guangzhou	
		21.5	25.8	36	Fuzhou	
<i>Pinus taeda</i>	—	16.4	36.4	38	Nanking	60%
		17.0	38.0	31	Guangzhou	
		10.1	15.1	16	Liuzhou	
<i>Pinus palustris</i>	1934	10.9	26.4	36	Nanking	
		21.0	27.0	36	Nansü	
		2.0	—	20	Lushan	

*Taxodium*: It has been forty to fifty years since *Taxodium* species were introduced to Nanking and Wuhan. Their characteristically fast growth and their ability to withstand strong wind and water-logged soil attracted the appreciation of the people and they soon became familiar trees in eastern and southern China.

TABLE 2. GROWTH OF AMERICAN SPECIES OF *Taxodium*

Species	Years of intro- duction	Growth			Locality	Fertility
		Av. height (m.)	DBH (cm.)	Age (yrs.)		
<i>Taxodium distichum</i>	1917, 1957, 1959	17.0	39.5	50	Nanking	low
		5.0	15.0	14	"	
		7.5-10	19-24	16	Wuhan	
<i>Taxodium ascendens</i>	"	14.0	30.5	50	Nanking	40-50%
		6.6	11.7	14	"	
<i>Taxodium mucronatum</i>	1933	21.0	80.0	40	"	low

TABLE 3. GROWTH OF AMERICAN SPECIES OF  
*Sabina* (*Juniperus*) AND *Cupressus*

Species	Years of intro- duction	Growth			Locality	Fertility
		Av. height (m.)	DBH (cm.)	Age (yrs.)		
<i>Sabina</i> ( <i>Juniperus</i> ) <i>virginiana</i>	1930	12.4	28.6	21	Nanking	high
<i>Cupressus</i> <i>lusitanica</i> var. <i>benthamii</i>	1959	13.0	30.0	20	"	difficult to form "female" cones
<i>Cupressus</i> <i>arizonica</i>	1934	9.0	23.6	24	"	low

*Cupressaceae*: Four genera [*Thuja*, *Cupressus*, *Chamaecyparis*, and *Sabina* (*Juniperus*)] and fifteen species of North American *Cupressaceae* have been introduced into China. Among them *Thuja occidentalis* and *Chamaecyparis lawsoniana* have always suffered from the hot dry summer in Nanking, and they prefer the mild summer climate at Lushan Botanic Garden (1100-1200 m.). *Sabina* (*Juni-*

*perus*) *virginiana*, *Cupressus lusitanica* var. *benthamii* and *C. arizonica* are three other species which were introduced into Nanking. Two ecotypes and various forms of *Sabina* (*Juniperus*) *virginiana* were found among the introduced population and the growth rate of the selected individuals exceeded that of both *Biota* (*Thuja*) *orientalis* and *Sabina* (*Juniperus*) *chinensis*. *Cupressus lusitanica* var. *benthamii* grows faster than local *C. funebris* and it has even surpassed exotic pines, but the cold spring in Nanking prevents it from fruiting.

The newcomers among Taxodiaceae are *Sequoia sempervirens* and *Sequoiadendron giganteum*, both of which were bestowed upon the Botanic Garden of Hangchow by former President Nixon as a token of friendship between the Chinese and American peoples. Chinese silviculturists are busy attempting to establish a redwood forest along coastal regions in Chekiang province.

Other conifers besides those mentioned above include:

<i>Cupressus goveniana</i>	<i>Pinus leiophylla</i>
<i>C. macrocarpa</i>	<i>P. monticola</i>
<i>C. macnabiana</i>	<i>P. muricata</i>
<i>Pinus banksiana</i>	<i>P. virginiana</i>
<i>P. glabra</i>	<i>Pseudotsuga menziesii</i>

#### BROAD-LEAVED TREES

Only about thirty genera and fifty species of North American broad-leaved trees have been introduced into China. Two members of the family Leguminosae — *Robinia pseudoacacia* and *Amorpha fruticosa* — are the most popular ones among them. The former made its earliest appearance at Tsingtao more than seventy years ago and since then it has been widely planted in the cities and the countryside at regions between Lat. 23°–46° N and Long. 86°–124° E.

*Liriodendron tulipifera* was introduced to Nanking in 1936, and 40-year-old trees are now 20 m. high with a DBH of 60 cm. Artificial pollination or mass planting has been necessary since the abundant flowers of a solitary tree rarely yield fertile seeds. Hybridization between the Chinese and American species was carried out by the late Professor P. T. Yeh of the College of Technology of Forest Products, Nanking, in 1963 and 1965. The average increments in height and diameter of the  $F_1$  hybrid trees were 42.3% and 13.7% respectively, and the date of abscission of the leaves came later than that of either of the parents.

The Pecan (*Carya illinoensis*) was introduced into China about seventy-five years ago with Nanking as the center of introduction. Trees 55-years-old had an average height of 20 m. with a DBH of 85.4 cm. The mature trees were all raised from chance seedlings. Five fruit types were identified, but the productivity was low and unstable, 60 kg. being the highest yield per fruiting tree, with an average of only a few kilograms. The introduction of better clones and

the improvement of horticultural practices will be necessary for good nut production.

*Magnolia grandiflora* and *Platanus occidentalis* are two attractive garden trees introduced to the Yangtze Delta some fifty years ago. The lustrous evergreen leaves and magnificent white flowers of the former often win the admiration of the public.

Other examples of the introduced broad-leaved species include:

<i>Acer negundo</i>	<i>Diospyros virginiana</i>
<i>A. saccharum</i>	<i>Fraxinus americana</i>
<i>A. saccharinum</i>	<i>F. pennsylvanica</i> var. <i>lanceolata</i>
<i>Calycanthus fertilis</i>	<i>F. rotundifolia</i>
<i>Campis radicans</i>	<i>Gleditsia triacanthos</i>
<i>Catalpa</i> × <i>hybrida</i>	<i>Gymnocladus dioicus</i>
<i>C. speciosa</i>	<i>Hypericum densiflorum</i>
<i>Cercis canadensis</i>	<i>Juglans nigra</i>
<i>Cornus amomum</i>	<i>Liquidambar styraciflua</i>
<i>C. sericea</i>	<i>Populus canadensis</i>
<i>C. pubescens</i>	<i>Ulmus americana</i>

## Discussion

1. The adaptability of the trees introduced from North America has proved superior in eastern China to that exhibited by trees originating in the Mediterranean region and central Asia. From a phytogeographic point of view there is a close but temporally remote relationship between the floras of North America and eastern China. This has been verified by successful plant introduction between the corresponding geographic regions of China and the United States, and it affords further possibilities for the mutual exchange of woody plants.

2. Whenever successful introduction is anticipated, one should locate introduced species in regions with ecological conditions more or less similar to those in their native environments. The sensitivity of southern pines and other coniferous trees from North America to changing growing conditions should never be overlooked. Selection for clones of suitable provenance is desirable whenever possible.

3. Selection of desirable variants from populations of different provenances should be carried out at a suitable time. Hybridization between Chinese and North American tree species could eventually give promising results (e.g., *Liriodendron chinense* × *L. tulipifera*, *Carya illinoensis* × *C. cathayensis*, *Taxodium ascendens* × *Cunninghamia lanceolata*, *Cupressus arizonica* × *Cryptomeria japonica*, *Pinus taeda* × *P. yunnanensis*, etc.).

4. We are looking ahead to promote and strengthen the mutual exchange of trees and other plants between our two countries and to learn from our American colleagues.



*The Dawn Redwood, Metasequoia glyptostroboides, is one of the most notable plants introduced from China in the last 30 years, and the Arnold Arboretum is responsible for having distributed it widely throughout the world. Native to only a small area in China and with no close relatives, it is perhaps the most uniquely Chinese of plants. Besides being an outstanding ornamental, it has an interesting history in that it was described from fossil remains before living plants were known to exist. The first living material was collected in 1944 by Tsang Wang, a Chinese forester. The specimen above, planted across Meadow Road from the Administration Building, is one of the most shapely and conspicuous in the Arnold Arboretum.*



# The Mexican White Pine

by JEANNE SMITH

The Arnold Arboretum has more than 40 species of pine growing on its grounds from throughout the geographic range of the genus. The Mexican White Pine, *Pinus ayacahuite*, is particularly intriguing because it is the Arboretum's southernmost representative of the genus as well as being one of the very few Mexican plants hardy here. The 24-year-old specimen, propagated from seed from the Royal Botanic Garden, Kew, England, is located in the conifer collection in Kent Field. Not only does it demonstrate the remarkable quality of being hardy in the Boston area, but it exhibits outstanding ornamental features as well. Branched to the ground, it is densely pyramidal, with slightly ascending branches in relatively regular whorls. The needles, arranged in groups of five, are about five inches long, glaucous-green and pendent. The tree has been compared to the Himalayan Pine, *P. griffithii*, because of its drooping foliage, but exhibits a somewhat denser habit. It rivals our native Eastern White Pine, *P. strobus*, with the handsome bluish cast of its stouter, longer needles.

Although an outstanding representative of the soft pines (subgenus *Haploxylon*), *Pinus ayacahuite* is virtually unknown to the American gardening public, found in only a small number of arbore-

*Jeanne Smith was a horticultural trainee at the Arnold Arboretum during the summer of 1978. This article is adapted from her report on a project which was part of her summer program. Present address: R.D.3, Box 19B4, Elizabethtown, PA 17022.*



A branch from a *Pinus ayacahuite* at the Masonic Homes Arboretum in Elizabethtown, Pennsylvania. Taken during the summer, this photograph shows both the previous year's mature cones and cones that will reach maturity in the fall.

ta, and rarely available as plants or seeds from nurseries and seed companies. This scarcity is due to two factors. One is the uncertainty of the plant's hardiness outside of its native geographic range. The other is that *P. ayacahuite* is one of a number of pine species that have shown considerable variability, resulting in a confusing taxonomic and nomenclatural history. A discussion of the complexity of pine genetics and the diversity of environmental conditions existing within the native range of the species in Mexico will help to clarify the situation.

All pines possess the same number of chromosomes,  $2n = 24$ , and the chromosomes themselves are relatively uniform morphologically. The conventional definition of a species cannot always be easily applied to the pines because genetic barriers to crossing are often absent; even well-defined species cross to produce fertile hybrids. As a result of interspecific hybridization, complexes or clines with intermediate forms can often be found where two or more species overlap geographically.

*Pinus ayacahuite* appears to be the southern representative of a north-to-south pine complex or cline of apparently intergrading species. The cline begins with *P. flexilis* James, in the mountains of western North America from southern British Columbia and Alberta southward to New Mexico. Its range overlaps that of *P. strobiformis* Engelmann, which ranges from southern Colorado to San Luis Potosi in Mexico. The cline ends with *P. ayacahuite* Ehrenberg, which

reaches from Jalisco and Hidalgo in central Mexico southeastward to El Salvador and Honduras.

*Pinus ayacahuite* was first described in 1838 by Ehrenberg. In 1909 G. R. Shaw described two new varieties of *P. ayacahuite* distinct from the typical southern variety: *P. ayacahuite* var. *veitchii*, found in the central states of Mexico, and *P. ayacahuite* var. *brachyptera*, from the northern states. Since 1909 the nomenclature associated with the northern variety has resulted in a confusion of synonyms: *P. ayacahuite* var. *brachyptera*, *P. strobiformis*, *P. flexilis* var. *reflexa*, and *P. reflexa*. However, most authorities now consider this plant to be a distinct species, *P. strobiformis*.

Recent work by Andresen and Steinhoff clearly distinguishes *Pinus strobiformis* and *P. flexilis* and establishes the range of variation in critical characters, but further study is needed to determine the relationship between *P. strobiformis* and *P. ayacahuite*. As a result of this situation, an evaluation of the horticultural merits of plants labelled *P. ayacahuite* can be made only after one determines whether the plant is the true species, one from a range of intermediates between two species, or a hybrid of two species formerly dissociated geographically but brought together in cultivation.

As a geographic area, Mexico possesses a remarkably diverse range of environmental conditions: climates ranging from tropical to cold temperate, rainfalls from deficiency to abundance, and altitudes from sea level to snow-covered volcanic peaks over 4000 meters high. These factors may contribute to and explain the range of hardiness of *Pinus ayacahuite* specimens grown in American arboreta. For example, seed originally collected at sites with severe climatic conditions may yield plants exhibiting hardiness associated with such a climate. According to literature sources, *P. ayacahuite* grows high in mountain ravines with a warm- to cold-temperate climate in the southern Mexican states of Hidalgo, Puebla, Tlaxcala, and Vera Cruz, and southward to Guatemala.

A questionnaire was sent to U.S. arboreta indicating holdings of *Pinus ayacahuite* to obtain additional information on the hardiness, culture, and ornamental qualities of the species. Microfiche records from the Plant Sciences Data Center revealed specimens in nine arboreta. Of these, only five had specimens whose identity had been verified by a taxonomist: the Arnold Arboretum, Strybing Arboretum, University of Minnesota Arboretum, Westtown School Arboretum, and the Institute of Forest Genetics.

Positive identification of the specimens at the other arboreta is difficult because their trees mostly have not yet produced cones. Arboreta that have plants labelled but not conclusively identified as *P. ayacahuite* include Barnard's Inn Farm, Longwood Gardens, the University of Washington Arboretum, and the Masonic Homes Arboretum. Table 1 shows a list of arboreta, the source of their specimens, the year and form in which acquired, the identification number of the

TABLE 1. ARBORETA IN THE U.S. HAVING SPECIMENS LABELLED *Pinus ayacahuite*.

Arboretum	Verified by Taxonomist	Source of Specimen	Year Acquired	Form in Which		Arboretum I.D. Number	Minimum Winter Temperature
				Acquired	Acquired		
Arnold Arboretum, Jamaica Plain, MA	Yes	Royal Botanic Garden, Kew, England	1954	Seed	Seed	431-54-B	-9°F.
Barnard's Inn Farm, Vineyard Haven, MA	No	Westtown School Arboretum, Westtown, PA	1961	Seed	Seed	Conifer row 3, #3	0°-10°F.
Institute of Forest Genetics, Placerville, CA	Yes	Mexican National Institute of Forestry	1933	Seed	Seed	Ay-N4	Daily min. temp. for Jan. 33.9°F.
Longwood Gardens, Kennett Square, PA	No	Westtown School Arboretum, Westtown, PA	1960	Seed	Seed	602299	0°F.
Masonic Homes Arboretum, Elizabethtown, PA	No	Unknown	1936	Unknown	Unknown	None	-10°F.
University of Minnesota Landscape Arboretum, Chaska, MN	Yes, vegetative	Cabot Foundation, Harvard University	1961	Scion	Scion	60191	-25°F.
Strybing Arboretum, San Francisco, CA	Yes	Unknown	Unknown	Seed	Seed	xy-2439	22°F.
University of Washington Arboretum, Seattle, WA	No	Prof. Martinez, Mexico	1963	Seed	Seed	15-63	Av. daily temp. for Jan. 34.7°F.
Westtown School Arboretum, Westtown, PA	Yes	Moon's Nursery, Yardley, PA	1924	Plant	Plant	WS0523	0°F.

TABLE 2. DESCRIPTIONS OF SPECIMENS EXAMINED LABELLED *Pinus ayacahuite*.

SOURCE ACCESSION OR LOCATION	Arnold Arboretum 431-54-B	Masonic Homes Arboretum South of Formal Garden	Barnard's Inn Farm Conifer Row 3, #3
AGE	24 years.	42 years.	17 years.
HEIGHT	6.5 m.	12.1 m.	4.2 m.
NEEDLES	12-14 cm. long, bluish green, all edges serrate, with 4-5 bands of stomata on inner surfaces.	13.5-15 cm. long, bluish green, all edges serrate, with 4-5 bands of stomata on inner surfaces.	11-15 cm. long, bluish green, all edges serrate, with 4-5 bands of stomata on inner surfaces.
CONES	Cylindric with tapered apex, 14-17 cm. long $\times$ 3.2-3.5 cm. broad, pendent, deciduous, dull reddish brown, resinous at tips of scales, the peduncles 2.5 cm. long.	Cylindric with tapered apex, 20-23 cm. long $\times$ 3.5 cm. broad, pendent, deciduous, dull reddish brown, resinous at tips of scales, the peduncles 2 cm. long.	Cylindric with short-tapered apex, 11-13 cm. long $\times$ 5.5-6.0 cm. broad, pendent, deciduous, dull orange brown, resinous at tips of scales, the peduncles 1-1.5 cm. long.
SCALES	Margins not wavy, dark red-brown below umbo, 4.5 cm. long $\times$ 2 cm. broad, reflexed on upper third of cone.	Margins thin and wavy, light red-brown below umbo, 5.3 cm. long $\times$ 2.5 cm. broad, reflexed to varying degrees throughout.	Margins not wavy, dark red-brown below umbo, 3.5 cm. long $\times$ 2 cm. broad, scales not reflexed.
SEEDS	Pale gray-brown with dark brown streaks, the nut 8 mm. long $\times$ 5 mm. broad, the wing 19-22 mm. long $\times$ 6-7 mm. broad.	Pale gray-brown with dark brown streaks, the nut 9 mm. long $\times$ 6 mm. broad, the wing 27-33 mm. long $\times$ 9 mm. broad.	—



A mature cone of the *Pinus ayacahuite* at the Masonic Homes Arboretum. The ruler is in inches.

arboretum, and its minimum winter temperature. Only two arboreta — the Institute of Forest Genetics and the University of Washington Arboretum — have specimens propagated from seed originating in Mexico. It seems unfortunate that propagation and distribution of this species have been primarily by seed collected in arboreta rather than from wild-collected material given the possibility of distributing interspecific hybrids rather than the true species.

Branches and cones from trees in the Arnold Arboretum, the Masonic Homes Arboretum, and Barnard's Inn Farm were studied to verify the authenticity of the specimens. The results of the examination appear in Table 2. From a review of needle and cone morphology, the trees at the Arnold Arboretum and the Masonic Homes Arboretum appear to correspond with the literature describing the typical species and with pine taxonomist G. R. Shaw's specimens of *Pinus ayacahuite* in the Arnold Arboretum herbarium. This opinion is based on a comparison of needle size, color, serration and stomatic bands; cone shape, color and dimensions; and seed nut and wing dimensions and color. The sample from Barnard's Inn Farm agrees in needle characteristics. But it differs in the color and the sparse pubescence on its branchlets and more noticeably in the small size of its cone and seed and in its lack of reflexed cone scales. This specimen perhaps is a hybrid, judging from the intermediate trend of various characteristics and the fact that it presumably was grown from seed from an isolated arboretum specimen among numbers of other pine species.

The author is aware of only one commercial seed source in the United States for *Pinus ayacahuite*. The seedsman is Frank T. Sessock, 6045 Foley Lane, Central Point, Oregon 97502. The seed he offers is custom collected from selected trees in Mexico and must be ordered in advance of the collection season. The Arnold Arboretum has recently received seed of *P. ayacahuite* var. *veitchii* from a private source in Mexico and if proven hardy, the plants will be distributed to interested nurserymen and arboreta. The seeds germinate readily without stratification within 21–28 days of sowing. Asexual propaga-



*The 42-year-old Pinus ayacahuite at the Masonic Homes Arboretum. Pinus ayacahuite grows old with noteworthy dignity and beauty. It can be highly recommended for the large yard or as an informal hedge and can be used in public and industrial parks, on college campuses and for highway plantings.*

tion is an alternative if seed is unavailable. Hopefully, nurserymen recognizing the ornamental qualities of the species will begin to propagate by grafting, using scion wood from trees of proven hardiness and beauty. As noted above, propagation from seed from cultivated sources may result in hybrid plants.

To insure optimum growth, trees should be planted in well-drained



sandy silt to clay loam, pH 5.5–7.0, and located where they will receive full sun the major part of the day. In severe climates damage has been reported due to ice, wind, and heavy snow, but in general trees in the Northeast have suffered no more damage than *Pinus strobus*. *Pinus ayacahuite* is susceptible to white pine blister rust, but no actual case was reported by respondents to the questionnaire. In its native habitat it matures to heights of 60 to 100 feet. Forty- to fifty-year-old trees observed in the Northeast have not exceeded 55 feet, and these tend to have multiple upswept side branches producing a broad, dense, rounded crown.

I would like to thank Gary Koller and Richard Weaver for their assistance with this project. In addition, I would like to acknowledge and thank those individuals at the botanic gardens and arboreta mentioned in this paper who took the time and interest to respond to my questionnaire. Their comments contributed greatly to the success of this endeavor.

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## NOTES FROM THE ARNOLD ARBORETUM

Bob Williams is not an ordinary man.

This I have long suspected. Others, too, have not been unaware. Ask anyone who knows him. I did — and to a person they asked me to write just one thing: that he is an exceptional man.

Describe him to me, I asked. Tell me in one adjective how you would characterize this man who spent an unprecedented thirty-four years as Superintendent of the Arnold Arboretum, his career here ending with his retirement in June. A single adjective was not sufficient for many people. It was too limiting. Invariably they added a qualifying adverb: most.

“He was the most indispensable person at the  
Arnold Arboretum.”

“There was no one more humble.”

“Bob Williams? Most dependable person I’ve ever  
worked with.”

“You can look forever, but I guarantee you won’t find  
anyone more honest, more helpful or more diligent.”

Bob Williams was all of those things, of course, but he was really so much more. I like best the description of one perceptive staff member who likened him to the bees he has tended so assiduously on the Administration Building roof. On reflection, such an analogy



seems not at all inappropriate.

Activity is the hallmark of every hive, and Bob Williams's days — and nights — were full ones. He was industrious, certainly, and like a worker bee he rarely had a day off. Responsible for both security and maintenance, he was on 24-hour call, and numerous were the phone calls that would come in the quiet hours of the night or early dawn, summoning him from sleep. Because one man cared and because one man was always there, an entire staff could leave without a care at day's end, knowing that the Arnold Arboretum was secure.

Bees are great travelers, too, making anywhere from 40,000 to 80,000 trips to many times that number of flowers in order to produce just one pound of honey. A single bee would have to travel a distance equal to twice around the globe to produce that pound. How like that independent bee was Bob Williams! The odometer on his Chevrolet would certainly tell the tale, for this man was everywhere. Large parts of every day were spent on Arboretum roadways checking new plantings, supervising the installation of a new pipe, or extinguishing a brush fire. Nothing that happened on those 265 acres escaped his attention.

Many were the tasks that Bob Williams performed but few were the ones he talked about, for he was not a man to call attention to himself. When he saw something in need of repair or attention, he simply did it. He made no fuss and he told no one.

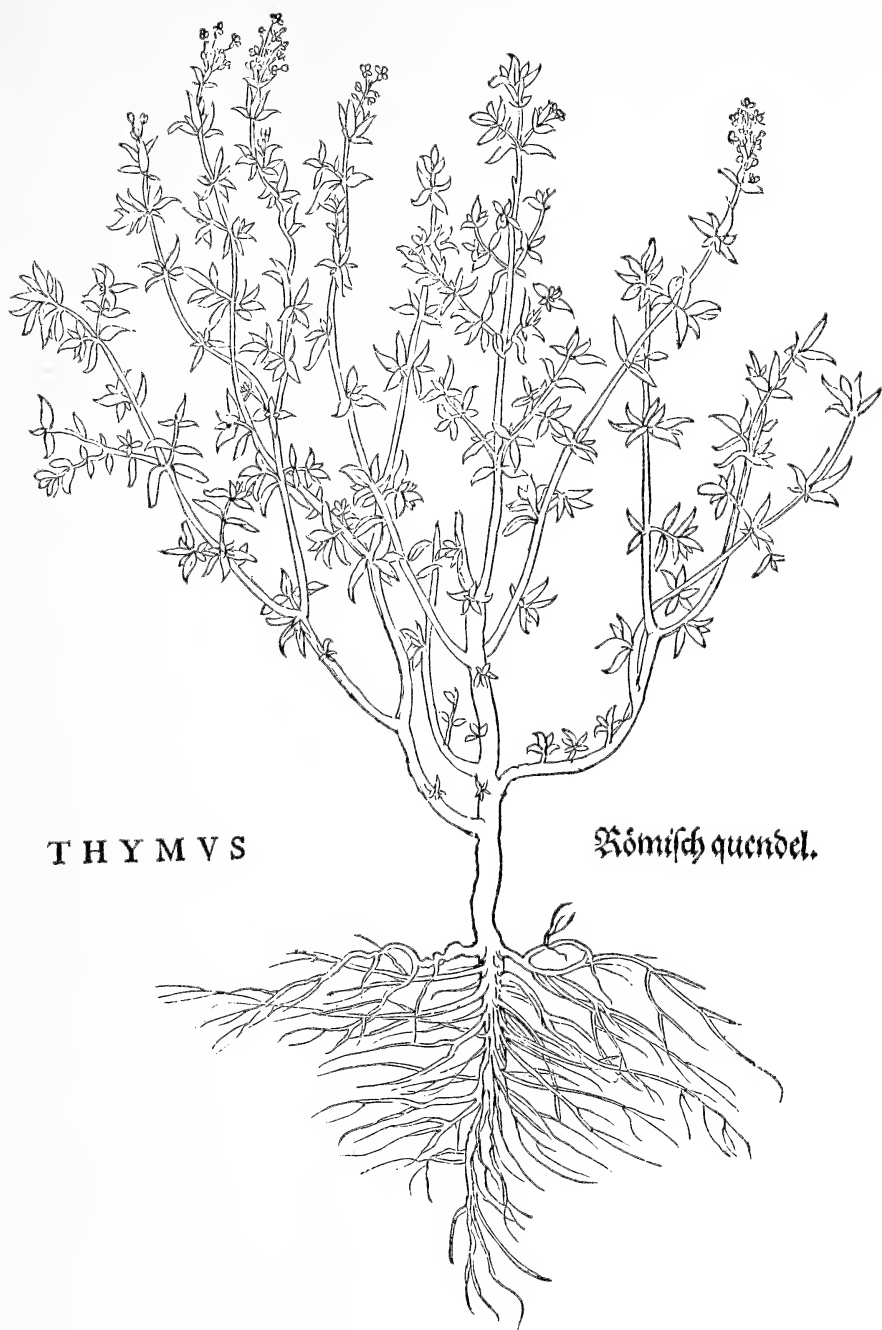
No problem was insurmountable. Oh, he might complain a little and mumble to himself about how in the world someone could be fool enough to jam the slide projector or get the venetian blinds tangled up in the window shades — always just moments before a lecture. But the knitted brows and the set of the mouth were really the most deceptive of façades. He always walked away shaking his head. It was part of his image. But more importantly — he always returned within moments, a piece of string, a pair of pliers, a ladder in hand. If the conventional approach wasn't feasible or if the tool to solve the problem didn't exist, he fashioned something workable from scraps of what he had. *That* was Yankee ingenuity! It was something Bob Williams knew all about.

There is something that those who worked with him know all about as well; that what Bob Williams was and what he did will not soon be forgotten. His selfless dedication and his tireless commitment are standards by which we might all measure ourselves. Bob Williams can take great pride in his accomplishments.

He is, after all, no ordinary man.

MARGO W. REYNOLDS

*Right: THYMUS. Back cover: VITIS.  
From De historia stirpium, Leonhard  
Fuchs. See page 259.*



THYMVS

Kömisch quendel.

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VITIS ALBA

Stickwurtz.

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# ARNOLDIA

*The Arnold Arboretum*

Vol. 39, No. 5

Sept./Oct. 1979



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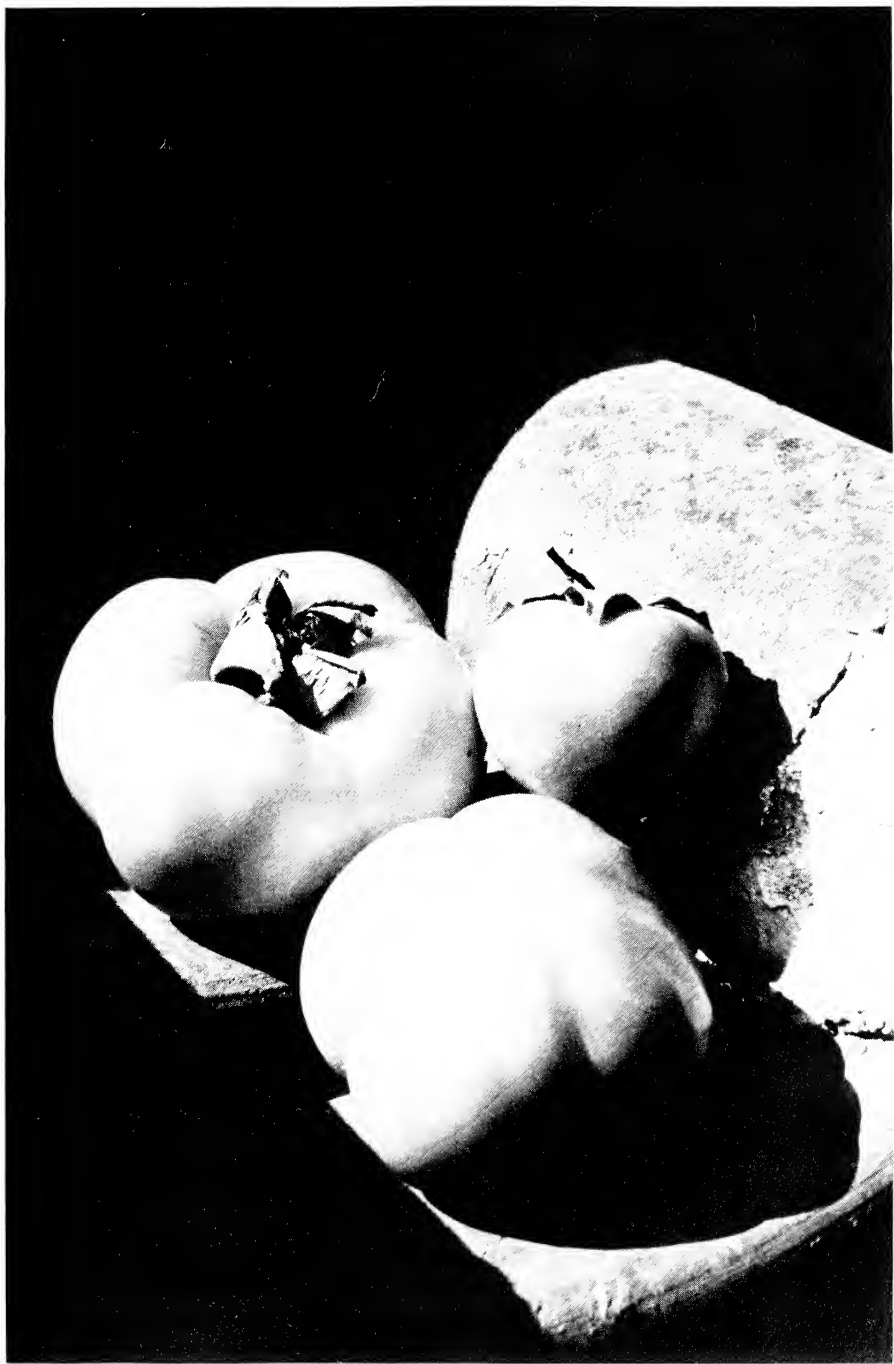
# Notes on Persimmons, Kakis, Date Plums, and Chapotes

by STEPHEN A. SPONGBERG

The genus *Diospyros* is not at present an important genus of ornamental woody plants in North America, and while native persimmons once were valuable fruits in the eastern United States, the fruits produced by *Diospyros* species no longer are important food items in the American home. In the countries of eastern Asia at least two species of *Diospyros* are among the most common trees encountered in doorway gardens and orchards, where they are cultivated for their edible fruits as well as for other uses and for their ornamental beauty. J. J. Rein, a German traveler and author, wrote in 1889 that *Diospyros kaki* Linnaeus f. was "undeniably the most widely distributed, most important, and most beautiful fruit-tree in Japan, Corea, and Northern China." And in Japan, where *D. kaki* is second in importance as an orchard crop only to citrus fruit, the kaki often is referred to as the national fruit (Childers, 1972).

The rarity with which species of *Diospyros* are found in cultivation in cool-temperate North America is partially due to the fact that most are native to regions of tropical and subtropical climate and are not hardy in areas of temperate climate. A member of the Ebenaceae or Ebony Family, the genus contains upwards of 400 species that occur

*Stephen A. Sponberg is a horticultural taxonomist at the Arnold Arboretum. He participated in the Arboretum's collecting trip to Japan and Korea in the fall of 1977, an experience which intensified his interest in persimmons.*



*Typical fruits of the kaki or oriental persimmon grown in dooryard gardens in Korea. Two types are shown, one with longitudinal furrows, the second completely smooth and unfurrowed. Photograph by S. A. Spongberg.*

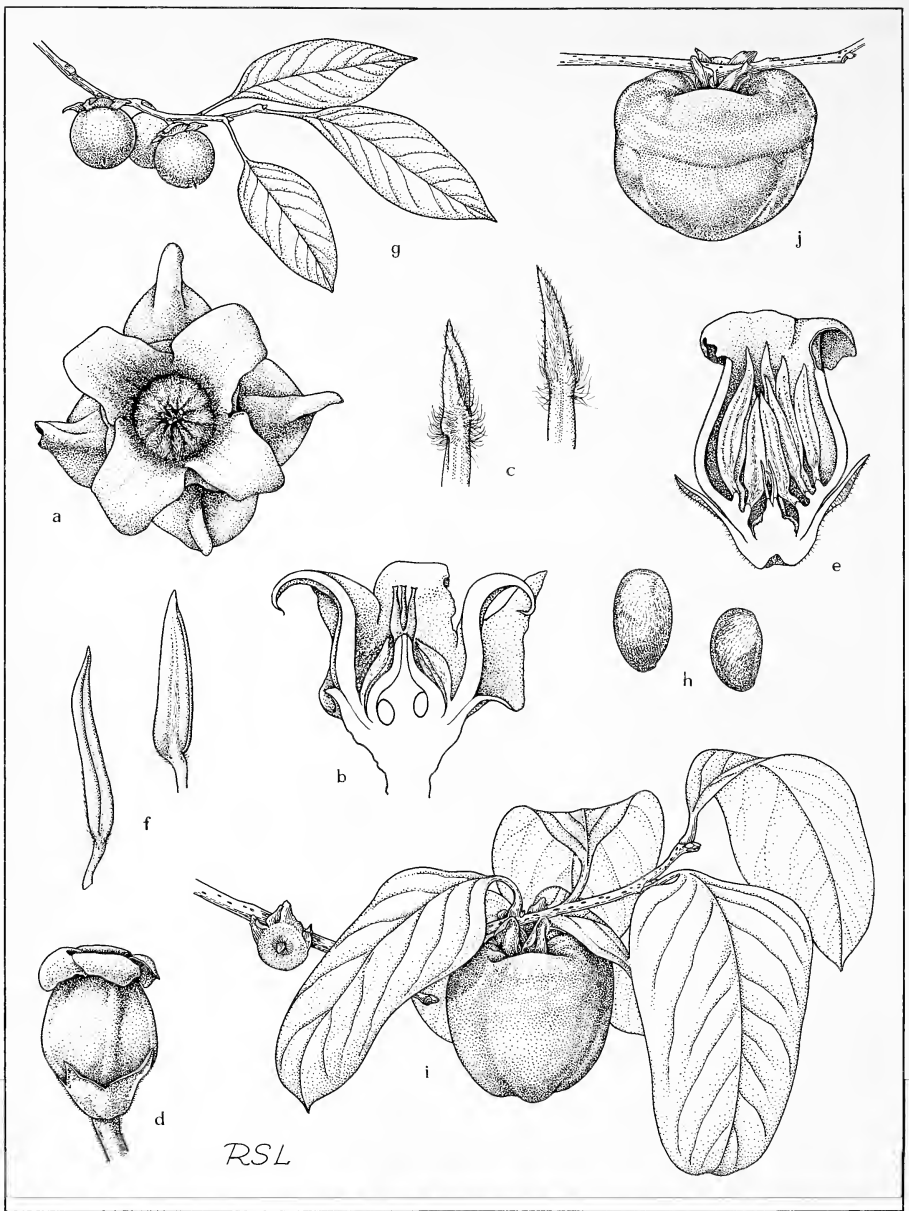


Figure 1. (a-h) *Diospyros virginiana*: (a) carpellate flower showing leafy calyx lobes, recurved corolla lobes, and staminodia over ovary,  $\times 3$ ; (b) longitudinal section of carpellate flower,  $\times 3$ ; (c) two staminodia,  $\times 6$ ; (d) staminate flower,  $\times 3$ ; (e) longitudinal section of staminate flower showing the stamens and non-functional gynoeceum,  $\times 4$ ; (f) functional stamens from staminate flower,  $\times 6$ ; (g) habit of fruiting branchlet of carpellate plant,  $\times 3/8$ ; (h) seeds,  $\times 1$ . (i, j) *D. kaki*: (i) habit of fruiting branchlet of carpellate plant,  $\times 3/8$ ; (j) fruit of the cultivar 'Tamopan',  $\times 3/8$ . Material of *Diospyros kaki* was kindly supplied by the Henry Foundation for Botanical Research, Gladwyne, Pennsylvania.

in both the Old and New Worlds with the greatest concentrations of species occurring in Madagascar (over 100 species), in Malaysia, and in Africa. The relatively few species native to regions of temperate climate come primarily from eastern Asia, but two species, *D. virginiana* and *D. texana* are indigenous to the United States.

A second reason even the hardy exotic and native species are rarely cultivated undoubtedly is related to a general lack of knowledge concerning when and how the fruits can be eaten, stored for future use, and prepared. While I always begin to look for persimmons in local markets and on Arnold Arboretum trees as the fall advances, many persons' experiences with these fruits understandably end when they first bite into a hard, astringent, and puckery persimmon. Such disappointments no doubt have contributed to a lack of demand for persimmons in American markets.

Despite the fancy prices asked for oriental persimmons or kakis in local vegetable stands and supermarkets, I am hopeful this article will stimulate enough interest to encourage readers to buy and enjoy a persimmon or two and to experiment with different ways of serving, and perhaps, preserving them. If native or American persimmons grow nearby, they can be gathered at little or no cost. I also am hopeful that both the oriental and American species will be more widely planted both for their fruits and as biologically interesting ornamentals. To this end, a list is appended of the few nurseries known to me that supply persimmon plants and seeds.

### Characteristics of Hardy Exotic and Native Persimmons

The genus *Diospyros*, the name derived from the Greek *Dios*, of Zeus or of Jove, and *pyros*, grain, in allusion to the sweet fruits fit for the gods, consists of trees and shrubs, and while some are evergreen plants, all of the species considered below are deciduous. The wood of the majority of species is very hard with a watery sap, and the heart wood is often blackish. The heart wood of several of the tropical species, especially that of *D. ebenum* Koenig ex Retzius, is the source of ebony, a hard, black wood often used for piano keys and for other inlaid cabinetry work and undoubtedly the most widely-known product of this otherwise little-known genus. The bark varies from smooth and exfoliating in the chapote to deeply furrowed and checkered in the American persimmon. The simple, ovate or oblong to elliptic, glossy, dark green leaves are alternately arranged along the branchlets on short petioles, and the pinnately veined blades have entire, rarely ciliate, margins. The flowers, which are produced along the branchlets, usually of the current year's growth, in the axils of the leaves, are generally of two types that are arranged differently. The staminate or male flowers (Figure 1: d, e) are produced in shortly stalked cymose clusters of three or four flowers together, while the carpellate or female flowers (Figure 1: a, b) are generally solitary. The staminate flowers, which measure 6–14 mm. long are borne on short pedicels

that are surmounted by a small, usually four-lobed, greenish calyx, while the four whitish petals form a four-lobed, four-ribbed urceolate corolla that is much the size and shape of the corolla of a blueberry (*Vaccinium*) flower. Eight to twelve or sometimes sixteen lanceolate stamens (Figure 1: f) are attached to the inner wall of the corolla in one or two whorls, while an ovary is either absent altogether or poorly developed and functionless (Figure 1: e). The carpellate flowers also are produced on short pedicels that terminate in a four-lobed, green calyx, but the calyx lobes are much larger than in the staminate flowers, and leaflike, folded curiously downward along the median line. These lobes alternate with the four recurved lobes of the whitish to yellowish, more or less urceolate corolla and form a small flower whose shape is intriguing, especially when viewed from above (Figure 1: a). Inside the corolla, the globose, centrally located ovary is terminated by four or five styles (Figure 1: b), while curving over the surface of the ovary of most species are eight, silver-hairy, functionless stamens termed staminodia (Figure 1: c).

Like tomatoes, which they often resemble in size, shape, and coloration, the fruits developed from the carpellate flowers are technically berries (Figure 1: g, i, j). The seeds (Figure 1: h) are usually oblong in outline, and flattened, with tan to reddish-brown seed coats. Not all persimmons contain seeds, a phenomenon discussed below. The size and shape of persimmon fruits vary enormously, as does their color, which usually ranges from green through yellow to reddish-orange, brownish, blackish, or purplish when the fruits are ripe and edible.

The sexuality of persimmon trees and the production of persimmon fruits is poorly understood and in need of further detailed study. From what is known, persimmons are a biologically intriguing example of a variable and complex reproductive system. In general, the staminate and carpellate flowers are restricted to different individual plants, and the species is classified as dioecious (i.e., two households, male and female individuals separated). However, in some instances, flowers of both sexes occur on a single individual plant, a few branchlets of an otherwise carpellate tree bearing staminate flowers, or vice versa. Under these circumstances the species is said to be monoecious (i.e., one household, separate male and female flowers on the same plant). Yet another added complexity in *Diospyros* is that some plants consistently produce flowers of both sexes, but others change from year to year, producing flowers of both sexes in one year, but not in another. In still other, rarer instances, a few perfect flowers, that is, flowers that contain both functional male and female parts, may occur on staminate or carpellate plants or on plants producing both carpellate and staminate flowers.

Flowering occurs in late spring and early summer, usually during late May and June in the Arnold Arboretum, and swarms of small honey bees have been noted to work the flowers during this period.





*Fruiting branchlet of a carpellate tree of Diospyros lotus from Kwei Hsien, Shensi Province, China, where the local name, Ruan tze, signifies "round persimmon". Photograph by F. N. Meyer, September 10, 1914.*

Due to their small size, their nodding position in the leaf axils, and also because of their greenish and whitish to yellowish color, flowers of *Diospyros* are often unnoticed, and it may be only the activity of large numbers of insects visiting the flowers for pollen or nectar or both that draws attention to the fact the trees are in flower.

Initially green, hard, and with their high tannin content, extremely astringent, the fruits and their subtending calyces increase in size as the season progresses and gradually assume their mature color and texture. Depending on the cultivar, the fruits may ripen any time between July and December or even February, and, contrary to some reports, frost apparently is not necessary to reduce astringency or to hasten ripening. As a matter of fact, some cultivars of the oriental persimmon or kaki are sweet and edible when still green and hard, looking like, and with the texture of, green apples.

Ripe persimmons may either contain seeds, or, surprisingly, be totally free of seeds. Fruits containing seeds probably result from the normal sexual process whereby the egg cells contained in the ovules of the ovary of a carpellate flower are fertilized, and seeds and fruit develop. Seedless persimmons, on the other hand, develop without fertilization. The development of fruit without fertilization and hence without seeds is known as parthenocarpy. What factors are necessary to trigger parthenocarpic development in persimmons is not known to me and constitutes another aspect of the variable and complex reproductive mechanisms of the genus. Moreover, circumstantial

evidence involving a presumably totally carpellate tree of *Diospyros virginiana* in the Arnold Arboretum that regularly produces seed-filled fruits, yet is a considerable distance from the nearest staminate tree, suggests the possibility that some seeded fruits also may be produced without pollination and fertilization. The latter type of asexual seed production, termed *apomixis*, is known in some plant families, but has not been documented in *Diospyros* or the Ebenaceae. It might explain some of the variability of some species of *Diospyros*, including the kaki, and help in interpreting taxonomic complexities of the genus.

The species of *Diospyros* known to me to be cultivated in cool-temperate regions of eastern North America are discussed individually below, and the characters of their flowers, fruits, and habit, and their vegetative characteristics have been utilized to construct the following key for their identification.

### Key to the Species of *Diospyros* in Cultivation

- A. Plants usually trees, rarely shrubs; leaf blades membranaceous to subcoriaceous, (1.4–)4–16(–20) cm. long, distinctly petiolate; flowers appearing after the leaves; anther sacs dehiscent by long, longitudinal slits; carpellate flowers with staminodia; fruits reddish through orange to yellow or yellowish-brown, sometimes green or purplish, rarely black.
  - B. Branchlets  $\pm$  slender, glabrous or with grayish pubescence; staminate flowers 6–10 mm. long at anthesis; pedicels of carpellate flowers 2–7 mm. long, the corolla 5–12 mm. long; fruits to 4 cm. in diameter (very rarely larger).
    - C. Petioles (0.5–)1.8–3.2(–4.7) cm. long; staminate flowers 8–10 mm. long at anthesis; corolla of carpellate flowers ca. 12 mm. long, the four or five lobes 7–8 mm. long; mature berries reddish-orange to pinkish-yellow, rarely purplish or black, to 4 cm. (or rarely to 7.5 cm.) in diameter; seeds 11–17 mm. long. .... 1. *D. virginiana*.
    - C. Petioles 0.7–1.2(–2.0) cm. long; staminate flowers 6–7 mm. long at anthesis; corolla of carpellate flowers ca. 5 mm. long, the four or five lobes 2–3 mm. long; mature berries yellowish-brown to bluish-black, to 2 cm. in diameter; seeds 8–12 mm. long. .... 2. *D. lotus*.
  - B. Branchlets  $\pm$  stout, variously fulvous-pubescent; staminate flowers 11–14 mm. long at anthesis; pedicels of carpellate flowers 8–32 mm. long, the corolla ca. 15 mm. long; fruits to 7.5 cm. in diameter. .... 3. *D. kaki*.
- A. Plants often shrubs, sometimes small trees; leaf blades coriaceous, (1.4–)2.4–4.8 cm. long, subsessile; flowers appearing with the expanding leaves in spring; anther sacs dehiscent by short, apical slits; carpellate flowers lacking staminodia; fruits black. .... 4. *D. texana*.

### 1. *Diospyros virginiana* Linnaeus, Sp. Pl. 2: 1057. 1753.

The American persimmon, common persimmon, simmon, or possum wood is native to a wide area of the eastern United States, from southern New England and Long Island south to southern Florida, and westward into eastern Iowa, Kansas, Oklahoma, and eastern

*Sciurus Volans**Diospyros*

The fruits of the American persimmon (*Diospyros virginiana*) are an important item in the diets of many small mammals, including flying squirrels as shown here in a plate from Mark Catesby's *The Natural History of Carolina, Florida, and the Bahama Islands* (vol. 2, pl. 76, 1754).

The thick, "alligator-skin" bark of the American persimmon (*Diospyros virginiana*) is a good identification characteristic for the species as well as a noteworthy ornamental attribute. Photograph by R. E. Weaver.



Texas. Infrequent in southern New England, it reaches the northernmost limit of its natural distribution at Lighthouse Point in New Haven, Connecticut, but it is hardy further north and can be cultivated successfully throughout Rehder's Zone 4 (USDA Zones 5a and 5b). Common south of New England both east and west of the Allegheny Mountains, *Diospyros virginiana* is particularly plentiful in the southeastern states where it often invades fallow fields and forms dense thickets along roadsides, spreading by means of black, fleshy, stoloniferous roots. The trees usually grow in sandy, well-drained soils, but also occur in rich, wet soils of bottomland forests.

An extremely variable species over its wide range, known, for example, to have chromosome numbers of both  $2n = 60$  and  $90$ , the American persimmon occasionally develops a shrublike habit, but generally is a small tree to 10 or 15 meters, rarely to 35 meters, often with spreading and pendulous branches. The bark, hard and of a brownish or blackish color, is irregularly and deeply fissured into small, blocklike plates, and resembles that of the flowering dogwood, *Cornus florida* L. Recognition of the species in winter is made easier by the characteristic bark pattern; the lack of terminal buds on the branchlets as well as the solitary bundle scars centered in the leaf scars are other useful identifying characters when the trees are leafless. Variation in plant habit, in the pubescence of the branchlets and leaves, in leaf size and shape, and in fruit size, shape, and color has provided characters on which several varieties and forms of

*Diospyros virginiana* have been based. Most of these taxa are of localized occurrence on the western and southern edges of the species range. A summary of these taxa is not given here, but has been presented elsewhere (Spongberg, 1977, pp. 154, 155).

The fruits of the American persimmon vary in size from that of a small cherry to that of a large plum (Sargent, 1894, p. 10, footnote) about 4 cm. in diameter, and in color from orangish to pinkish-yellow, often with a grayish bloom when ripe, to dark purple or bluish-black in f. *atra* Sargent. The fruits are an important food to many forms of wildlife, and opossums, racoons, and squirrels often strip the trees of any fruits remaining on the branchlets during the winter months. The fruits also were important food items to the Indians of eastern North America as well as to the first European settlers and explorers. Easily grown from seed, American persimmons were sent back to England and established in English gardens some time before 1629 (Sargent, 1894).

The Spanish explorer Don Fernando de Soto learned of the food value of the persimmon from the Indians of Florida in 1539 and probably was the first European to write about the fruit. In the next century, Captain John Smith, among others, took an interest in the *putchamins* of the Indians and likened them to medlars (*Mespilus germanica* L.), noting that "if it not be ripe it will drawe a mans mouth awrie with much torment; but when it is ripe, it is as delicious as an Apricock" (quoted in Bailey, 1898, p. 172). The name *putchamin*, L. H. Bailey suggests, probably is a phonetic rendering of the Indian name for the plant.

Hedrick states that "of the several plants used by the Indians, two, the persimmon and sassafras, were of importance to the [colonists] of Maryland and Virginia" (1950, p. 115). European settlers in the southern states prepared a persimmon or simmon beer and used the fermented juice to distill an apparently very good brandy. In Pennsylvania, Isaac Bartram (1772) wrote a treatise on the preparation of persimmon wine. Persimmons also were eaten when ripe, or prepared in puddings, breads, or as preserves, while dried persimmons were stored and eaten as we eat figs and dates. The wood of the common persimmon has been valued for its hardness and density and has been used locally for innumerable items; it once was preferred for shuttles over any other American wood.

During the nineteenth and early twentieth centuries, considerable interest centered on the American persimmon as a potential orchard crop, and numerous cultivars, selected for fruit color, taste, size, and early maturation, were selected from wild populations and named. Lists and descriptions of many of these cultivars are included in the publications of Bailey (1925), Fletcher (1928, 1935), Troop and Hadley (1896), and Watts (1899). While interest in cultivars of *Diospyros virginiana* has continued to the present day, primarily in the Midwest (see the references by McDaniel, and Brooks & Olmo,

1972), to my knowledge American persimmons never have been grown successfully on a commercial scale. Undoubtedly, this in large part is due to the fact that the American appetite for persimmons is limited, and the California-produced oriental persimmons satisfy the current market demand. Nonetheless, local native and occasional cultivated trees help to satisfy those of us who enjoy our native persimmon.

Over and above its colorful small fruits, American persimmon is an attractive ornamental due to its graceful shape, its lustrous green leaves that turn scarlet in the fall, its adaptability to various soil types, and its general resistance to insect pests and diseases. Of considerable value to wildlife, American persimmon also has been suggested for planting in erosion control programs (Van Dersal, 1939).

## 2. *Diospyros lotus* Linnaeus, Sp. Pl. 2: 1057. 1753.

The date plum, *Diospyros lotus*, is very similar to the American persimmon in its morphology and may be the closest living relative of our native species. The two can be distinguished by the characters contrasted in the key above, but in all likelihood the date plum will be seen growing in North America only in botanical gardens and arboreta; no nurseries have been located that offer plants of the date plum, although at least one nursery offers seed. In the Old World, *D. lotus* is very widely distributed as a native, naturalized, or cultivated plant from southern Europe, the Caucasus, and Asia Minor eastward through the northwestern Himalayan region, and into China, Korea, and Japan. Cultivated since ancient times, the natural occurrence and original distribution of *D. lotus* no longer are possible to ascertain. In England and other areas of northern Europe, the date plum has been cultivated as an ornamental since the sixteenth century (Carder, 1975). In North America, the date plum is hardy at least as far north as the Boston area. It probably was introduced into North America when seeds were received at the Arnold Arboretum in 1884 from the Imperial Botanical Garden at St. Petersburg.

A small tree, usually with a rounded crown, that with age may attain 30 meters in height, *Diospyros lotus* is valued in Asia for its small, yellowish-brown to bluish-black fruits, which have a taste similar to dates and often are dried for winter consumption. The Chinese name for the species, *Ghae tsao*, signifies black date (Meyer, 1911). The fruits attain a diameter of about 2 cm., and those I have examined or eaten always have been almost completely filled with brown, oblong, and flattened seeds. Meyer (1911) reported a seedless type from China. The date plum is especially valued in eastern Asia as an understock onto which scions of the oriental persimmon are grafted.

*Diospyros lotus* grows, either as a native or naturalized plant, in rocky, protected ravines, along mountain streams, and on rocky



*An old tree of *Diospyros lotus* approximately 26 meters in height growing at the foot of Fei-Yüeh-ling, Ching Chi Hsien, western Szechwan Province, China. Photograph by E. H. Wilson, August 3, 1908.*



slopes. In Japan I saw a fruiting and healthy-appearing tree growing from a crevice in a rock outcrop on the Pacific Ocean beach at Matsushima. The date plum may prove of value as a small ornamental tree in coastal areas where salt spray limits the effective use of other ornamental species.

### 3. *Diospyros kaki* Linnaeus f., Suppl. Pl. 439. 1781.

The kaki, Chinese persimmon, Japanese persimmon, or oriental persimmon, with fruits sometimes the size of large tomatoes, is the persimmon that occasionally appears in American markets and abounds in markets in Japan, Korea, and China during the late summer and fall and into winter. Like the date plum, kakis have been cultivated for such an extended period of time that the natural species range has become totally obliterated. Grubov (1967), a Russian botanist, has suggested that the wild progenitor of the cultivated forms was native to northern China, while Rehder and Wilson (1916) state that *Diospyros kaki* var. *sylvestris* Makino, the reputed wild form of the kaki, with smaller, yellow, and often hairy fruits, is "abundant in the mountains of central and western China up to 4,000 feet altitude, where it forms a large tree 50 or 60 feet tall."

Due to the tremendous morphological variation exhibited by *Diospyros kaki*, botanists have questioned whether the cultivated forms might be of hybrid origin with two or more species in their genetic background (Hume, 1914). Other botanists have speculated that *D. kaki* might best be divided into more than one species (see, for example, Sargent, 1894, p. 4, footnote). In a recent article F. S. P. Ng (1978) suggests that domesticated kakis arose from *D. roxburghii* Carrière, a taxon of subtropical Asia that taxonomists often have included within *D. kaki*. Like *D. kaki* var. *sylvestris*, *D. roxburghii* differs from kakis primarily in its hairy fruits, and Ng asserts that it is possible "*D. kaki* [ $2n = 90$ , a hexaploid] arose directly from *D. roxburghii* [ $2n = 30$ , a diploid] through polyploidy, cultivation, and selection for smooth-skinned fruits."

That selection for differing fruit types has occurred is evidenced by the upwards of a thousand cultivars or forms of the kaki that are cultivated in Asia and maintained by ring-budding or grafting, primarily on date plum rootstock. Ranging in size from about 2 cm. in diameter, the size of a small plum, to about 8 cm. in diameter with a weight of over a pound, kakis can be astringent or sweet, seedless or seeded, and conical, round, flattened, or almost cubical in shape, and some cultivars have longitudinal or horizontal ridges or furrows. The 'Tamopan' or grindstone persimmon (Figure 1: j) is one of the bizarre forms, with an equatorial to near basal furrow, while the more regular, oblong-conical fruits of 'Hachiya' with rounded apices terminating in small, black, styler scars, are probably the most common kaki in American produce markets.

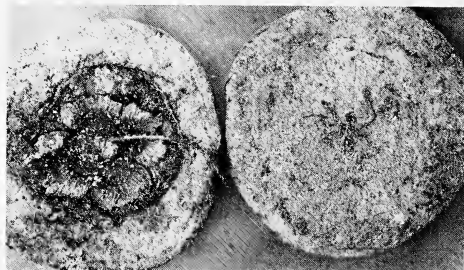
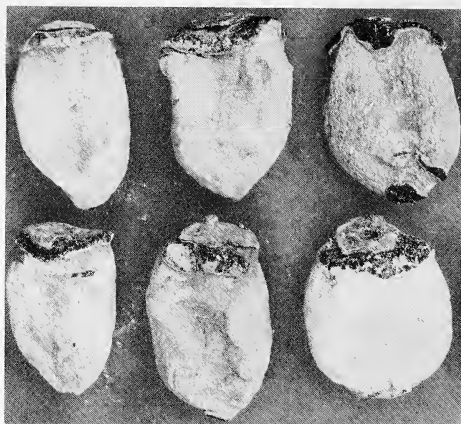


Above: Cords of peeled persimmons (*Diospyros kaki*) hung to dry in the village of Siku, Kansu Province, China, where the local name, Fang sze tze, signifies "square persimmon". Photograph by F. N. Meyer, November 16, 1914.

Sliced oriental persimmons (*Diospyros kaki*) drying on a wooden platform on a rooftop in the garden of Mr. Kim Chung-sok in Kwangyang, Cholla-namdo Province, South Korea. Photograph by S. A. Spongberg, October 12, 1977.

As noted previously, the astringency of persimmons is a variable character caused by tannins that, depending upon the cultivar, may or may not be present when the fruits are green and hard. Some forms never lose their astringency, even when soft. The tannin-bearing cells are scattered in strands throughout the flesh of the fruit, and the tannin is associated with a mucilage-like carbohydrate that coagulates and "absorbs" the tannin during ripening. Oxidation of the absorbed tannin causes the tannin-filled cells to turn red in some cultivars; the strands of cells are then easily distinguished (Condit, 1919). Kaki fruits are also very high in vitamin C and sugar content (glucose ca. 18%), the latter a variable character, like astringency, but have relatively low percentages of protein and fat (Condit, 1919). In Japan, hard, astringent persimmons were sometimes placed in used sake casks or tubs to ripen, and according to Rein (1889, p. 88) these "tub persimmons", which absorbed the flavor and perfume of the sake, were considered a delicacy. However, the Japanese apparently often ate the hard, unripened fruit, a fact that prompted Charles Sargent to observe that the kaki was "consumed in immense

*Diospyros kaki*. Top: Six small dried persimmons with the crystallized sugar from which small cakes are made locally. Obtained in Ssu shui, Honan Province, China, where the local name, Hui sze ping, is translated "boil-proof dried persimmon", referring to the fact that the fruit retains its shape even when boiled a long time. Bottom: One of the largest dried persimmons of China, most of the fruits measuring 10 to 11 inches in circumference. Formerly, fruits of this type were given as a tribute to the Imperial Court at Peking and sold at more than twice the amount paid for other varieties. The Chinese name, Ching sze ping, means "green dried persimmon". Photographs and notes by F. N. Meyer, April 21, 1914.



quantities by the Japanese, who eat it, as they do all their fruits, before it is ripe, and while it has the texture and consistency of a pavingstone" (1894a, p. 50).

Unlike Americans, who regard the kaki as a fresh fruit to be eaten when ripe or rarely frozen for later use, the peoples of eastern Asia for centuries have dried the fruits for storage and use during the winter and early spring months. The persimmons, either whole or sliced, and occasionally skinned, are dried in the sun until their flesh attains the consistency of a dried fig. I have seen sliced persimmons drying on wooden platforms on rooftops in Korea, while a photograph taken by Frank N. Meyer, Agricultural Explorer in China for the U.S. Department of Agriculture early in this century, shows the fruits strung on stout cords and suspended from a simple scaffold to dry in the sun and wind.

As they dry, or during a curing process after drying, sugar crystallizes on the surfaces of the fruits that are high in glucose content. By the time they are ready for storage or shipment, the flesh has turned blackish, and the sugar coating the surface is similar in texture to confectioner's or powdered sugar (S. Y. Hu, personal communication, and Meyer, 1915). Depending on the cultivar, the surface of the dessicated fruit may be evenly coated with sugar, or the sugar may appear in irregular scablike patches. Dried fruits, which become flattened if suspended on a cord while drying or which may be flattened mechanically after drying, are known as pressed persim-

mons; these are packed in boxes in Japan, while in China they often are stored on the cords. Dried kakis are eaten out of hand or stewed much the same way we stew dried apicots and prunes. In China they are a particular favorite during the New Year celebration in February. Once the spring rains begin and atmospheric humidity increases, the surface sugar liquifies, and the dried fruits no longer are considered edible (S. Y. Hu, personal communication).

Meyer's photographs also document another form in which the white, crystallized sugar is prepared for future use. In certain areas of China, the sugar is scraped from the surfaces of the dried kakis and compacted into thin, round cakes or loaves, while sugar of the highest quality is pressed into molds to produce ornamented tablets. The Chinese characters on the surface of the tablets photographed by Meyer (see page 306) signify "double happiness": couples engaged to be married often present these tablets to friends from whom they have received wedding gifts. The tablets of sugar also are served as one of the eight comestibles offered with tea during the first course of traditional Chinese banquets (S. Y. Hu, personal communication).

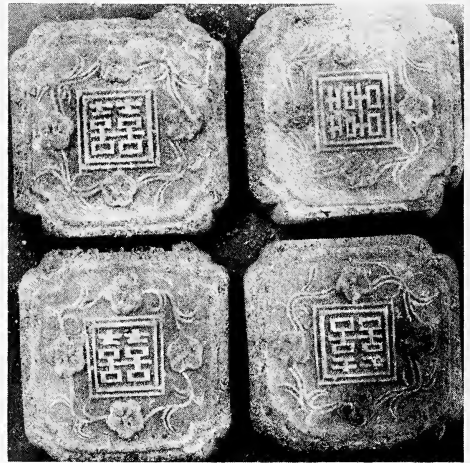
The kaki is grown in Asia for more than its edible fruits. Numerous medicinal properties have been attributed to different parts of the plants. The green unripe fruits of what in China is known as the oil persimmon, *Diospyros kaki* var. *sylvestris*, the reputed wild form of the domesticated kakis, are used to make a varnish oil that renders hats and umbrellas waterproof (Wilson, 1913, p. 73). In Japan, Shibu, a highly astringent, milky, light or dark gray fluid rich in tannin, is prepared from unripe kakis and date plums during the summer and is used to toughen paper, wood, and fishnets. It also is required in one stage of the complicated process of making fine Japanese lacquer work and in the preparation of sake and certain dyes. Rein (1889, p. 265) notes that in Japan the kaki is a favorite subject for bonsai.

Sir Joseph Banks, botanist on Captain James Cook's first voyage around the world, is credited with the introduction of *Diospyros kaki* into Europe, while the first trees of the kaki in North America probably were grown from seeds obtained in Japan by Commodore Perry in 1856. Likened by some to an apple or pear tree in size and shape, but with larger, lustrous green leaves that turn scarlet in the fall, when it is particularly handsome with its brilliant fruits, the kaki was considered by Sargent to be the most beautiful of any fruit tree of cold temperate climates. Knowing that the kaki is hardy in Peking, Sargent (1894a) speculated that it would be hardy in New England "if plants of a northern race can be obtained." Unfortunately, kakis, even some grown from seed obtained near Peking, never have survived in the Arnold Arboretum for longer than a few growing seasons. Young trees are growing on Martha's Vineyard, and beautiful old trees (one the 'Tamopan') growing at the Henry Foundation for Botanical Research attest to their hardiness in the Philadelphia area.



Above: A basketful of pressed dried persimmons (*Diospyros kaki*) offered for sale in a market in Peking. Photograph by F. N. Meyer, March 22, 1913.

Right: Square tablets of persimmon sugar obtained from the dried fruits of a variety with the Chinese name, Pen sze sse. The Chinese characters signify "double happiness". Photograph by F. N. Meyer, Peking, April 19, 1914.



According to fairly recent statistics (U.S.D.A., 1975), cultivation of kakis for the American market is totally confined to California, where on the average only 1,910 tons (compared with 20,000 tons for dates and 112,000 tons for plums) were harvested annually between 1970 and 1974. We hope that seeds collected from persimmons in a very cold district of Korea during the Arnold Arboretum collecting trip in 1977 will provide at least one reliably hardy strain for New England.

#### 4. *Diospyros texana* Scheele, *Linnaea* 22:145. 1849.

Unlike the carpellate flowers of the American persimmon, the date plum, and the kaki, carpellate flowers of the chapote, black persimmon, or Mexican persimmon lack sterile stamens or staminodia. Moreover, the flowers appear on the branchlets of the previous year's growth, and the anthers of the staminate flowers open by short, apical slits, while those of the other species dehisce by longitudinal slits that continue down the entire length of the anther. These dif-

ferences help to distinguish *Diospyros texana* from the other species of the genus and were considered by John K. Small of enough significance to merit placing *D. texana* in a separate, monotypic genus, *Brayodendron*. However, most botanists have continued to regard the chapote as a unique species of *Diospyros*.

The chapote further differs from the other species discussed in this article in its shrubby, often many-stemmed habit, although it may develop into a single-stemmed, twiggy tree that occasionally reaches 25 meters in height. The bark of the chapote also is distinctive; it is smooth, light reddish-gray or reddish-brown, and the outer layers exfoliate in irregular sheets, exposing the smooth, gray, inner bark. In appearance, it is reminiscent of the mottled bark of the crape-myrtle (*Lagerstroemia indica* L.) and is one of the characters that recommend the chapote as an ornamental plant.

Native to the United States, the chapote is distributed in central and western Texas and ranges southward into the Mexican states of Coahuila, Nuevo León, and Tamaulipas. Over its range it grows in rich moist soils of bottomlands as well as on dry rocky mesas and in isolated canyons. The small, hairy, black fruits mature to 2.5 cm. in diameter. When mature, they are sweet but rather insipid. They leave an "indelible black stain upon everything with which [they] come in contact" (Standley, 1924, p. 1127) and have been used by Mexicans of the Rio Grande Valley to dye sheepskins.

Sargent (1894, p. 12) notes that this species should prove valuable as a cultivated ornamental for its attractive, lustrous foliage, the interesting black fruits of the carpellate plants, and its mottled bark. It is recorded as cultivated in Virginia and in Pennsylvania, and although it has not yet proven hardy at the Arnold Arboretum, it may be hardy as far north as southern New England. Trials of *Diospyros texana* grown from seed collected on the northern edge of its range in Texas may provide plants hardy in Boston; seed would be gratefully received by the Arnold Arboretum staff for this purpose.

### Eating Persimmons

The kakis I have found to be available in Boston markets should be fully ripe before eating; at this stage the fruit is soft to the touch over its entire surface, the skin is slightly loose and feels as if it could be slipped off the flesh, and the green calyx can be pulled off with relative ease. Likewise, my experience with American persimmons is that they should be equally as soft when eaten. Since all the American persimmons I have gathered have been filled with seeds, I have seeded them and used the pulp in persimmon pudding, served with heavy cream or ice cream. I mostly enjoy eating kakis out of hand, but the flesh can also be used in recipes for pudding, ice cream, and bread; I have always wanted to experiment with a kaki chutney.

While the kakis in markets usually are hard, they will ripen with

time at room temperature. But don't be too eager to bite into one or you may never be tempted again. It has been suggested that putting persimmons in a plastic bag with an apple will hasten ripening. Recipes using persimmons are not found in many standard cookbooks. The *Joy of Cooking* (Rombauer & Becker, 1964) includes recipes for ice cream, an exceptionally good pudding, and Japanese persimmon salad, and *Stocking Up* (Stoner, 1973) offers notes on freezing persimmon pulp for future use. The U.S.D.A. Farmers' Bulletin 685 (Fletcher, 1928, 1935) contains the widest variety of recipes for persimmon pulp, including recipes for bread, crumpets, griddlecakes, persimmon-peanut muffins, persimmon cake, pudding, ice cream and sherbet, persimmon taffy and fudge, and persimmon whip. Fletcher notes that "since heat makes the astringency . . . more apparent, it is always well to add one-half teaspoon of baking soda to each cup-full of persimmon pulp in all recipes where the fruit is subjected to heat" (1928, p. 22). The soda is not necessary if the fruits are completely ripe.

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#### Appendix: Nursery Sources for *Diospyros*

The following nurseries are known to me to have offered *Diospyros virginiana* plants in recent catalogues. Only one, Mellinger's Nursery, has offered both *D. virginiana* and *D. kaki*. Before ordering from any of the nurseries, written inquiry should be made to determine selling practices and availability.

Boyd Nursery Company, Inc., P.O. Box 71, McMinnville, Tennessee 37110

Brimfield Gardens Nursery, Rocky Hill, Connecticut 06067

Greenbrier Farms, Inc., 201 Hickory Road, West, Chesapeake, Virginia 23322

Hess' Nurseries, Inc., P.O. Box 326, Route 553, Cedarville, New Jersey 08311

The Home Nursery, C. S. Ingels & Sons, P.O. Box 148, Route 17, Lafayette, Illinois 61449

Mellinger's Nursery, 2310 West South Range, North Lima, Ohio 44452

The following nursery offers seed of *Diospyros kaki*, *D. lotus*, and *D. virginiana*:

F. W. Schumacher Co., Sandwich, Massachusetts 02563

These lists undoubtedly omit many nurseries that offer persimmon plants or seeds; their exclusion is by no means intentional.



*Collinsonia canadensis* from Linnaeus's *Hortus Cliffortianus* (pl. 5, 1737). The genus *Collinsonia*, comprising a few species of herbaceous plants entirely North American in distribution, was named by Linnaeus in honor of Peter Collinson, the sponsor of John Bartram and other early American plant collectors.

# Spreading Roots

by CORA L. WARREN

When the Pilgrims landed in America in 1620, though the coast was "stern and rock-bound," and the immediate vicinity "full of woods and thickets" (Bradford, 1897), the Northeast was by no means covered by forest. As Betty F. Thomson points out, almost without exception the earliest explorers and settlers commented on the treeless areas they saw, from the Saco Valley south as far as and beyond the Hudson, and up into the river valleys of New York State. Verrazano, travelling from Narragansett Bay in 1564, reported "open plains twenty-five or thirty leagues in extent, entirely free from trees or other hindrances." In what are now our Southern states the same open plains existed.

These great tracts had been cleared by the Indians for their farming, and the underbrush in the forests was set on fire every spring to improve the growth of grass necessary to game animals.

Edward Hyams observes that had the Pilgrims made their land-fall further north, in Maine, they would have found cultivated orchards of apples and pears, planted a good ten years before their arrival by the Baron de Saint-Castine and his French colony. Indeed, the French in Canada initiated the flow of plants eastward. Many

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of the plants the English settlers found in New England already were growing in the Jardin du Roi in Paris.

Myth and fancy have long been a part of our image of our forefathers. Research into the horticultural practices of the time and attention to the revelations in contemporary accounts help to dissipate some of the untruths.

Picture, if you will, what might be regarded a typical early New England scene. A log cabin stands in a clearing, its doorway framed on one side by a lilac bush, and on the other by a forsythia. Near the house is a pond, over which a weeping willow droops. A pasture stretches beyond, bright with dandelions, daisies, and red clover. A house mouse sits by the cellar door, hoping for a handout and keeping a wary lookout for the red fox skulking in the wood.

This nostalgic picture is false in every particular. The scene described could not have been found in its entirety before the nineteenth century.

Log cabins did not exist in the first English colonies. They first were built by the Swedish in Delaware between 1637 and 1665. Most of the houses built in Boston by the first English settlers were made from boards cut from the black locust tree (*Robinia pseudoacacia*) (Miller, 1763).

As for the plants mentioned, the common lilac (*Syringa vulgaris*) was the earliest plant to reach this country from Europe, but it is not native. Introduced to Europe by way of Turkey during the reign of Queen Elizabeth, its date of entry into America is in some dispute. Lilac is mentioned growing in New Amsterdam in 1655. It was a much loved shrub, one of the very few imported plants that was not thought to have medicinal value. In the next century, covered wagons carried lilacs to the Far West.

Forsythia (*Forsythia suspensa*) was a much later introduction. Originally from China, it was introduced from Japan into Holland in 1833 by Verkerk Pistorius. It reached England in 1844. American horticulturists learned of it in 1846 from British journals and were quick to import it.

Peter Collinson, the Quaker botanist, recorded the arrival of the weeping willow (*Salix babylonica*) in England in 1740: "Mr. Vernon, Turkey merchant at Aleppo, transplanted the Weeping Willow from the River Euphrates and brought it with him to England. It was planted at his seat at Twickenham Park where I saw it growing in 1748. This is the original of all the Willows in England." According to a possibly apocryphal, but pleasant story, Alexander Pope, the "Wicked Wasp of Twickenham", planted a willow from a green withe on a package of figs sent from Smyrna by his friend Lady Suffolk. The tree flourished, and the story has it that a young British officer carried a twig to America, where it was planted in Abingdon, Virginia, and gave rise to most of the weeping willows in the United States.

The field strewn with familiar wild flowers certainly had wild flowers, but they could not have been the ones listed. Dandelions are not native, but escapes from cottage gardens, where they were grown for "sallets". Daisies (*Chrysanthemum leucanthemum*) also were garden escapes. Red clover (*Trifolium pratense*) came by ship with the cattle, as did Queen Anne's lace (*Daucus carota*), chicory (*Cichorium intybus*), most weedy buttercups (*Ranunculus*), orange hawkweed (*Hieracium aurantiacum*), and a host of others. John Josselyn recorded in 1672 "some forty kinds of weeds sprung up since the English planted and kept cattle in New England." The expectant house mouse also came with the cattle. The red fox, although indigenous to the Far West, was brought to the eastern seaboard by English gentry for hunting.

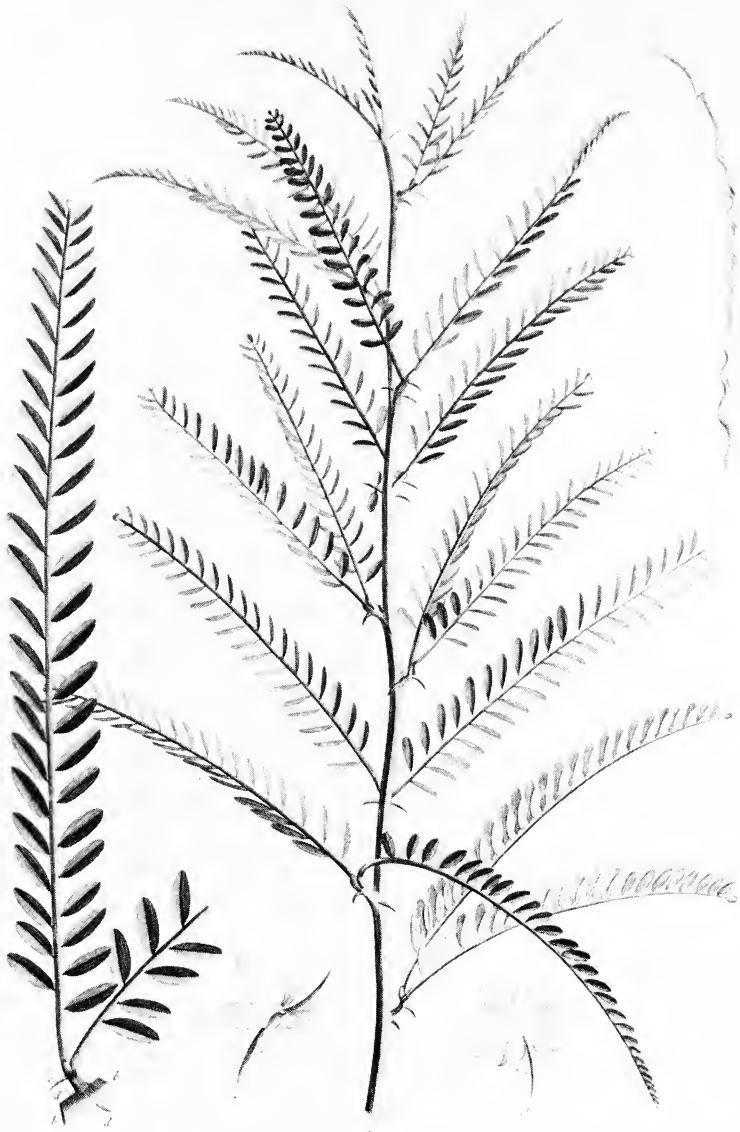
Contrary to a widely held image of the native American Indians as painted savages, tomahawks raised high, the Indians met by the Pilgrims were as often curious, even helpful, as hostile. The first Thanksgiving feast was shared by Pilgrims and Indians.

Many of the Indians in the North had gardens of a kind, where they grew maize, beans, pumpkins, squash, tobacco, and a few flowers, including roses and sunflowers. They knew how to force seeds into germination by sowing them in a compost of powdered, rotten wood placed in flat boxes of bark, which were hung in the smoke of the cooking fire. They also were aware that it was important to grow plants in isolation to obtain a pure strain.

Corn, when planted by hand according to the Indian method, requires neither draft animals nor farm equipment: "Their manner of planting is this, they make a hole in the earth with a sticke, and into it they put foure graines of corn and two of beanes . . . their women and children do continually keepe it with weeding" (Thomas Harriott, "A briefe and true report of the new found land of Virginia", 1590). William Bradford relates how the Puritan settlers were taught how to plant corn by Squanto, an Indian who had been to England and could speak English. "Also he tould them excepte they gott fish & set with it (in these old grounds) it would come to nothing" (Bradford, 1897). It has been claimed that the Puritans might well have starved without the native knowledge of planting corn by hand (Hedrick, 1950). Indeed, what seed had been brought from England failed the first year: "Some English seed they sew, as wheat & pease, but it came not to good, eather by the badness of the seed, or lateness of the season, or both, or some other defecte" (Bradford, 1897).

Pumpkin or pompion (*Cucurbita pepo*) was another plant among the Indians' principal crops which the English settlers immediately adopted. From "The Forefather's Ballad", handed down from early days in the Plymouth Colony, comes a plaintive cry:

We have Pompion at morning and Pompion at noon,  
If it were not for Pompion we should be undone.



One of the palo verdes (*Parkinsonia aculeata*) from Linnaeus's *Hortus Cliffortianus* (pl. 13, 1737). These shrubs or small trees of the legume family are native to Mexico and southern Arizona, but they are widely cultivated throughout the desert regions of the southwestern United States and have become naturalized in many areas. The genus was named by Linnaeus in honor of John Parkinson, one of the foremost English herbalists.

For all the knowledge gained from the Indians, the original settlers were not as proficient farmers as one might suppose. According to the anonymous author of *American Husbandry* (1775), the "embattled farmers" were "the greatest slovens in Christendom." Once a field had been cleared and exhausted, it was far easier to clear more land than to go through the arduous process of renewing the soil. The destruction by English farmers of the primeval forests continued in far greater measure what the Indians had begun. The truth of the matter is that to the early settlers there seemed to be an unlimited supply of land; at least so they acted. George Washington described the problem further in a despairing letter to Arthur Young:

. . . the aim of the farmers in this country, if they can be called farmers, is, not to make the most they can from the land, which is, or has been cheap, but the most of the labour, which is dear; the consequence of which has been, much ground has been scratched over and none cultivated or improved as it ought to have been; whereas a farmer in England, where land is dear, and labour cheap, finds it his interest to improve and cultivate highly, that he may reap large crops from a small quantity of ground.

The German farmers in Pennsylvania, more frugal and efficient by far than the English, were an exception.

In the South the land was even more acutely decimated by the "one crop" system. Tobacco, cotton, and indigo plantations exhausted the soil.

It was not only farming that changed the virgin territories. The settlers built their ships from white oak (*Quercus alba*), and their fences and furniture from the eastern red cedar (*Juniperus virginiana*). They made their torches from the pitch in pines, their brooms and wheels from pignut (*Carya glabra*), the black powder for their muskets from the pussy willow (*Salix discolor*), and beer from the sweet birch (*Betula lenta*). Many species suffered for their utility. Flowering dogwood (*Cornus florida*) was badly decimated in New England because of the excellence of its wood for spindles. By 1750 the Atlantic white cedar (*Chamaecyparis thyoides*) had become extremely scarce; the whiteness of its wood made it attractive for flooring, and whole logs often were used in house building.

The great stands of white pine (*Pinus strobus*), some containing trees 150 feet high, were the worst to suffer. England needed masts for her navy, and paid as much as one hundred pounds apiece for the taller trees. Indeed, the quarrel between England and her American colony over the ownership of the great white pine forests acerbated an already tenuous relationship. The English marked the trees suitable for masts with a blaze known as the King's Broad Arrow, reserving the trees for the Crown, and severely punished those pioneers who ignored the hated sign. The pioneers retaliated by dressing



as Indians, who were exempt from the restriction, and cut down the trees at night. The revolutionaries clad in Indian garb who threw the tea into Boston Harbor thus had a precedent of many years standing. The importance of the disputes over the white pine is memorialized in the revolutionary flag of Massachusetts, which depicts a single white pine.

An interesting aspect of the early settlers' use of plants is the role played by plants in the slowly emerging discipline of medicine.

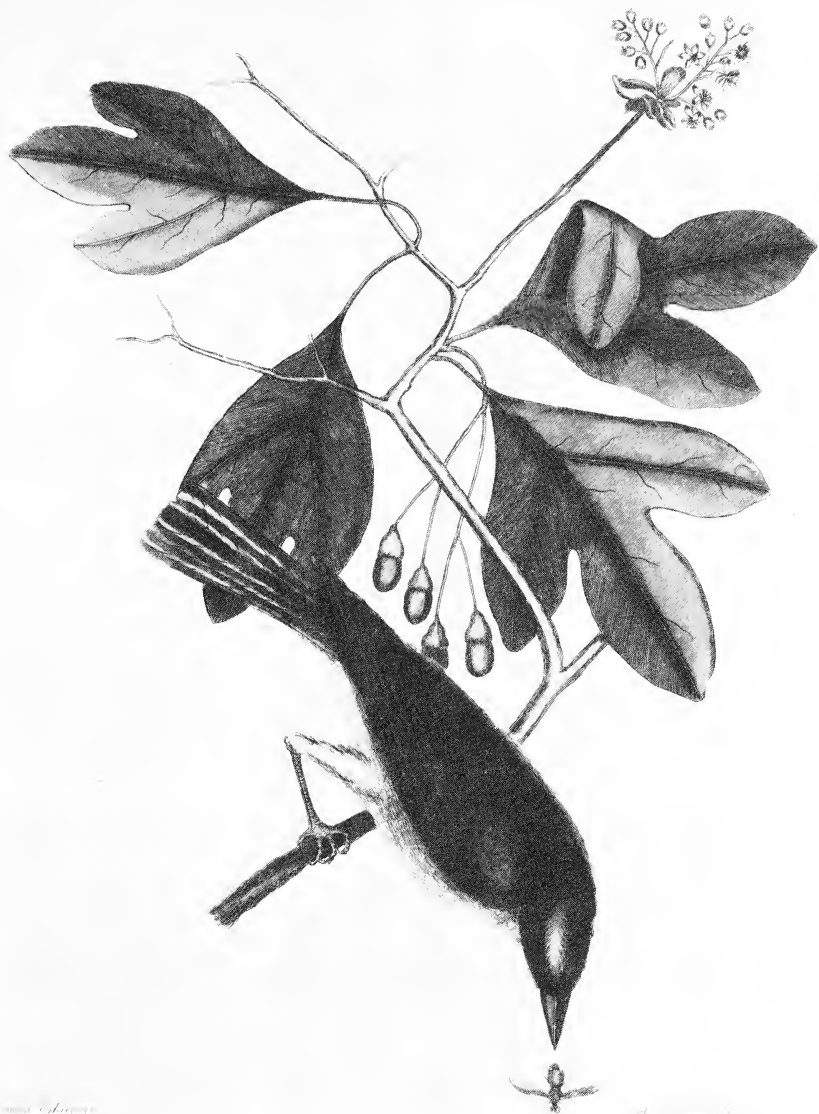
The Puritan housewife, living in a totally religious culture, still held to the medieval belief that God had created all plants for the use of mankind. Thomas Hooker (1586–1647), minister of Hartford and one of New England's most powerful preachers, elucidated this doctrine in "The Application of Redemption" (1659): "For al outward things are for the body, the body for the soul, the soul is nextly for God."

Herbals were indispensable to the pioneer household. The best were those by John Gerard and John Parkinson. Gerard, Warden of the Company of Barber-Surgeons in London, published his herbal in 1597; it was corrected and amplified in 1633 by Thomas Johnson. Gerard had a wide acquaintance among plant collectors. Parkinson, botanist and apothecary, published *Paradisi in sole, paradisus terrestris* in 1629. (The title, literally, "terrestrial paradise of the park in the sun", is a pun on the author's name (Henrey, 1975).) The first known copy of Parkinson's herbal in New England was in the library of Leonard Hoar, President of Harvard College. After Hoar's death, this copy was given to Increase Mather, and his son Cotton Mather.

Closely following the precepts of these herbals, the housewife grew in her garden plot such plants as comfrey (*Symphytum officinale*) for bruises and broken bones, false hellebore (*Veratrum viride*) for scurvy, borage (*Borago officinalis*) — "Borage always brings courage," as Parkinson translated Pliny — and a host of other dubious remedies.

However, a new concept in the curing of disease was beginning to be explored. The Doctrine of Signatures no longer was in high repute, and it was believed that there might be a universal panacea for all mortal ills. Sassafras (*Sassafras albidum*) was believed by both the Indians and the newly arrived settlers to be this universal remedy. It was one of the first exports sent by Captain John Smith from the Jamestown Colony. In 1602 the price of sassafras in England was 336 pounds sterling the ton. Merchants of Bristol, England, sent two ships across the Atlantic in 1603 for the sole purpose of gathering sassafras, finally finding it near Long Island Sound. Thomas Jefferson regarded it as a purely ornamental plant, so presumably by his time belief in its curative powers had been abandoned.

Despite what might seem in some aspects a bleak picture of ignorance, cupidity, and bad land management, the discovery and colonization of America resulted in an exchange of flora between nations which benefited mankind both horticulturally and aesthetically.



*Sassafras* (*Sassafras albidum*) and "The Tyrant" (actually the eastern kingbird, *Tyrannus tyrannus*), from Mark Catesby's *The Natural History of Carolina, Florida, and the Bahama Islands* (vol. 1, pl. 55, 1754). Many of Catesby's plates include both flowers and fruits on the same branch, which at least in the case of the sassafras is unlikely to occur in nature. As shown in the legend, Catesby compared sassafras to the cornelian cherry (*Cornus mas*), a plant which it superficially resembles in flower.

When one considers that the voyage from England to America and back, even as late as 1702, when the first Atlantic mail service was inaugurated, took anywhere from 90 to 116 days, it is astounding how many plants were imported and exported. Only about six American plants were in cultivation in England before 1600. By 1700 there were 150, and in the next century hundreds more. Science universally was regarded as having no concern with political squabbles, so the constant wars of the first two hundred years had little effect on the movements and affairs of botanists, except for the additional risk of loss of material at sea.

Because of the depletion of English forests, trees were the original exports. Northern white cedar (*Thuja occidentalis*) was the first tree sent to Europe from America; according to Alfred Rehder, it is probable that it first was sent to France in 1536. It reached England sometime between 1536 and 1596. The only pine growing in England at this period was the Scotch pine (*Pinus sylvestris*). By 1743 the pitch pine (*P. rigida*), and the scrub pine (*P. virginiana*), and other conifers such as the balsam fir (*Abies balsamea*), the Atlantic white cedar (*Chamaecyparis thyoides*), the eastern red cedar (*Juniperus virginiana*), and the eastern hemlock (*Tsuga canadensis*) had all crossed to England.

As early as 1670 the English introduced Mediterranean fruits into the southern states. Oranges, lemons, apricots, limes, and pomegranates were grown at the Charles Town Colony. Some fruits from Europe had reached America before the English. Peaches were introduced by the Spaniards into Florida. The Indians became so fond of the fruit that by the time of the first English settlements, peach trees were found growing in Indian villages as far north as they would grow, and west to the present states of Arkansas and Texas. Peach brandy was one of the first drinks made by the colonists.

Many of the trees we now take for granted as our own are not native. The "Tree of Heaven" (*Ailanthus altissima*), the white poplar (*Populus alba*), the European weeping birch (*Betula pendula*), the horse chestnut (*Aesculus hippocastanum*), and the Norway maple (*Acer platanoides*) all were sent from England in the late seventeenth and early eighteenth centuries.

The peanut (*Arachis hypogea*) which originally was carried from South America to the Old World tropics by Portuguese sailors, was brought to Virginia on the slave ships from Africa. Other ethnic groups increased our horticultural stock. Homesick Scots introduced ling (*Calluna vulgaris*). The Netherlands brought a wide range of flowers, including numerous sorts of roses, crown imperials (*Fritillaria imperialis*), lilies (*Lilium candidum*), peonies, and, of course, tulips.

Besides the importations by the various ethnic groups, and the unnamed settlers and housewives, there were individuals who earned a place in history by their contributions to the exchange of plants. The

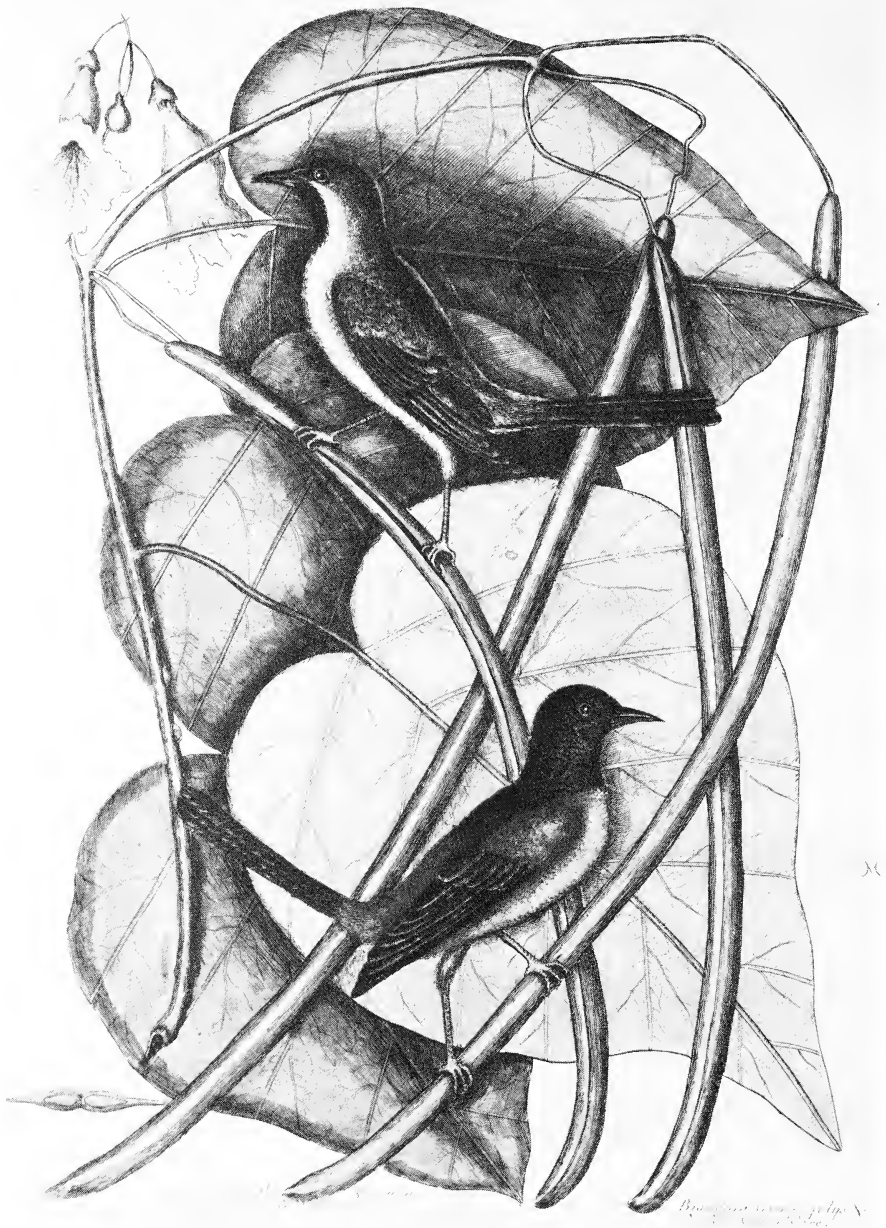
two John Tradescants, father and son, can be regarded England's first plant explorers. John the Elder, who died in 1638, had travelled to Russia, Algeria, and Holland as gardener to Charles I. John the Younger, sent to Virginia by his father in 1637, also made two later journeys, bringing home a wide variety of material. The American columbine (*Aquilegia canadensis*), the cardinal flower (*Lobelia cardinalis*), beebalm (*Monarda fistulosa*), sundial lupine (*Lupinus perennis*), the New England aster (*Aster novae-angliae*), red-osier dogwood (*Cornus sericea*), and a spiderwort, which Linnaeus named *Tradescantia virginiana* in the elder Tradescant's honor, were all growing in the Tradescant garden by 1656. The younger Tradescant also introduced to England the tulip tree (*Liriodendron tulipifera*), the American plane tree (*Platanus occidentalis*), and the red maple (*Acer rubrum*).

Linnaeus (Carl von Linne, 1707–1778), the Swedish botanist, was the first to devise a usable and uniform system of binomial nomenclature, as well as a readily accessible system of classification. His system brought order out of a chaos that had obtained since the days of Dioscorides, and was of immeasurable value to collectors like Mark Catesby, and John Bartram, both of whom were among his correspondents. Linnaeus also named many plants. Several early American plant explorers, and their European correspondents and patrons, are memorialized in his generic names: for example, *Banisteria*, *Collinsonia*, *Fothergilla*, *Kalmia*, and *Tradescantia*.

Henry Compton, Bishop of London, Head of the Church for the American Colonies, was an early patron of plant exploration in North America. He grew over a thousand species of tropical plants and about half as many hardy trees and shrubs in his famous garden and greenhouse at Fulham Palace, and he sent John Banister (1654–1692) to America. Banister compiled a catalogue of American plants and was the first to send back to England the sweet bay (*Magnolia virginiana*), the swamp azalea (*Rhododendron viscosum*), and the Virginia bluebell (*Mertensia virginica*). He died young and tragically, during a trip to the lower Roanoke River in Virginia, when another man on the trip mistook him for a wild animal and shot him (Ewan & Ewan, 1970).

Indeed, it is surprising that as many botanists survived as did, so parlous were the times. From 1702 to 1783 the English, and frequently their American colonies, were engaged in Queen Anne's War, the War of Jenkins's Ear, King George's War, the French and Indian War, and, finally, the War for American Independence. Totally undaunted by these disturbances, the collectors went about their business with a dedication and fervor at which we can only marvel.

Mark Catesby (1682–1749), an English botanist, made two long trips to America and the Bahamas, and after twenty years of work, published, in 1747, *The Natural History of Carolina, Florida, and the Bahama Islands*. Peter Collinson wrote to Linnaeus, "Catesby's noble



One of Mark Catesby's notable plant introductions to England, the common catalpa (*Catalpa bignonioides*) is still considered in that country to be among the finest of summer-blooming trees. In the plate above, from Catesby's *Natural History* (vol. 1, pl. 49, 1754), the catalpa is a backdrop for "The Bastard Baltimore" (the orchard oriole, *Icterus spurius*); the accompanying description was the first published account of the plant.

work is finished." Noble it is indeed, the first natural history of this country, magnificently illustrated in large part by Catesby, who taught himself engraving to accomplish it. He was as avid a collector as the other early plant explorers, sending his seeds back in gourds, and was responsible for introducing to Britain the American beauty berry (*Callicarpa americana*), the common catalpa (*Catalpa bignonioides*), sourwood (*Oxydendrum arboreum*), and the Virginia Stewartia (*Stewartia malachodendron*).

Peter Collinson (1694–1768), a London Quaker merchant, was another moving force in the exchange of plants between America and Europe. He corresponded with Georg Stellar, a German plant collector in Russia, and with Pierre d'Incarville, a French botanist exploring in China, but is most famous for his long correspondence with John Custis, father-in-law of Martha Custis Washington, and his thirty-five year friendship, by letter, with John Bartram. He sent Custis double Dutch tulips, Guernsey lilies (*Nerine sarniensis*), carnations, and auriculas among many other plants. In return, Custis sent him such native shrubs as bayberries (*Myrica pensylvanica*), mountain laurel (*Kalmia latifolia*), and yaupon (*Ilex vomitoria*).

One of the many letters Collinson sent to Custis introduced "a downright plain countryman." This was John Bartram (1699–1777), a Philadelphia Quaker and widely travelled farmer, who taught himself Latin and botany, and through Collinson's efforts in his behalf, was made botanist to King George III in 1765. An even more impressive tribute came from Linnaeus, who said that Bartram was "the greatest natural botanist in the world". Bartram harvested the first American rhubarb, and flowered the first horsechestnut (*Aesculus hippocastanum*) in his garden on the banks of the Schuylkill River, the first botanic garden in America, and one of the first to become commercial. He introduced more than two hundred plants to England during the years he and Collinson conducted their "settled trade and business". Goat's-rue (*Tephrosia virginiana*), wild monkshood (*Aconitum uncinatum*), the common shootingstar (*Dodecatheon meadia*), wild sweet william (*Phlox maculata*), and poison ivy (*Toxicodendron radicans*) were but a few of his offerings, the last mercifully a failure in England. On his last expedition, when over seventy years old, he discovered with his son William a stand of franklinia (*Franklinia alabamaha*) in Georgia. Fifteen years later William returned to the spot and gathered seeds. The Bartrams called the tree "Franklinia" after "the illustrious Dr. Benjamin Franklin." It has not again been found in the wild since the early nineteenth century.

William Bartram (1739–1823) did not have the tremendous staying power of his father and drifted from job to job with no success. An excellent draughtsman, he finally was paid by Dr. John Fothergill to collect plants in Florida, and made a long journey through the southern states. The journey is described in his curiously illustrated book *Travels through North and South Carolina, Georgia, East and*



Mountain Laurel

*Mountain laurel* (*Kalmia latifolia*) from *The North American Sylva* ( vol. 2, pl. 68, 1818) of F. Andrew Michaux, who traveled with his father André through the southeastern United States. A widespread shrub of our Eastern forests, *Kalmia latifolia* is the most familiar member of a small genus of American shrubs named by Linnaeus in honor of one of his students, Peter Kalm, who explored eastern North America on behalf of the Swedish government in 1748.



*West Florida*, published in Philadelphia in 1791, fourteen years after William completed his travels. The book supplied imagery to Coleridge, Wordsworth, and Chateaubriand. To the Indians, Bartram was known as Puc Puggy, the Flower Hunter.

Other countries than England produced dedicated collectors. Pedr (Peter) Kalm (1715–1779) was Finnish. A pupil of Linnaeus, who maintained that “all Lapland could be rendered fertile by the introduction of appropriate American plants,” Kalm’s travels through America were as much a commercial as a botanical expedition. He visited Bartram in Philadelphia, admiring his encyclopedic knowledge, as did everyone who knew him. Kalm collected in Canada as well as the Delaware River region, returning to Sweden in 1751 with a harvest of new material, to the delight of Linnaeus, who rose from a sick bed to welcome him.

The French botanist André Michaux (1746–1803) visited England in 1779, bringing home many of the foreign plants in cultivation there. Marie Antoinette sent Michaux to Asia with Xavier Rousseau (cousin of the philosopher), and Michaux sent home from Aleppo his first collection, including *Michauxia campanuloides*, a flower greatly admired by the Victorians, but now not often seen in cultivation. Continuing on his own through Syria and Persia, Michaux brought back among other treasures, *Rosa persica*. In 1784, together with his fifteen year old son and the Scotsman John Fraser, Michaux explored and collected in Georgia and South Carolina. He also made many expeditions on his own, from Florida to Hudson’s Bay and as far west as the Mississippi. He started a nursery at Ten Mile Station, north of Charleston, and from seed brought by sailing ships trading with China, he introduced to America the maidenhair tree (*Ginkgo biloba*), the crape-myrtle (*Lagerstroemia indica*), the silk tree (*Albizia julibrissin*), and many other important additions to our cultivated flora. He brought or sent back to France an immense collection of 60,000 living plants and ninety consignments of seeds.

These dedicated explorers and collectors were supported by a wide spectrum of patrons. Benjamin Franklin was a staunch friend and supporter of Bartram and Collinson. In Collinson’s account book one finds the Dukes of Norfolk, Richmond, Bedford, and Argyle, and the Lords Petre, Bute, Leicester, and Marlborough; nurserymen, lady gardeners, and Virginia plantation owners also contributed for plant collecting. Even the Prince of Wales twice begged and paid for boxes of plants. The burgeoning interest in plants transcended the still rigid class system, and a man with a new or curious plant was welcome at any door.

Having begun with an impossible picture, we can end our brief history by describing two actual eighteenth century gardens. George Washington and Thomas Jefferson were eager collectors and cultivators. Mt. Vernon and Monticello, both brilliantly laid out, both replete with fine trees, shrubs, and flowers from both sides of the Atlantic,

represent the epitome of what could be done with what had been discovered in the plant world.

Mt. Vernon, designed with meticulous care by Washington, was so ambitious, so demanding with its large variety of material, that it is no wonder his papers contain a great number of questions and directions concerning every sort of shrub and tree. Throughout the French and Indian War, the Revolution, and his terms as President, he wrote a steady stream of detailed instructions to a succession of overseers, ordered plants from various nurseries, Bartram's among them, and asked for advice and stock from gardening friends. His plantation was the delight of visitors, and his loving care and incessant planning is reflected even today in the excellent restoration of his property. It was from Mt. Vernon in 1797 that he wrote a Mr. J. Anderson: "I am once more seated under my own vine and fig tree . . . and hope to spend the remainder of my days . . . in peaceful retirement; making political pursuits yield to the more rational amusement of cultivating the earth."

Thomas Jefferson, among his myriad other talents, was an accomplished naturalist and botanist. He began planting at Monticello in 1766, keeping a garden book in which he entered every plant he used, noting its progress, and, in the case of vegetables — every one of which he grew, with all its varieties — when it came up, and when it was eaten. While at the French Court from 1784 to 1789, he sent home hundreds of seeds and roots. In England he made a study of the great gardens and from his notes incorporated many of their features at Monticello. His plantings were informal and eclectic, and included figs, acacias, pomegranates, almonds, olives, and nectarines, as well as the more familiar nut and fruit trees: walnuts, peaches, filberts, cherries, apples, plums, and pears. Monticello also is now restored to much of its former splendor.

Our difficult beginnings culminate here triumphantly. We forever should be grateful for those men who established such strong roots across the Atlantic and whose roots, today, still are spreading.

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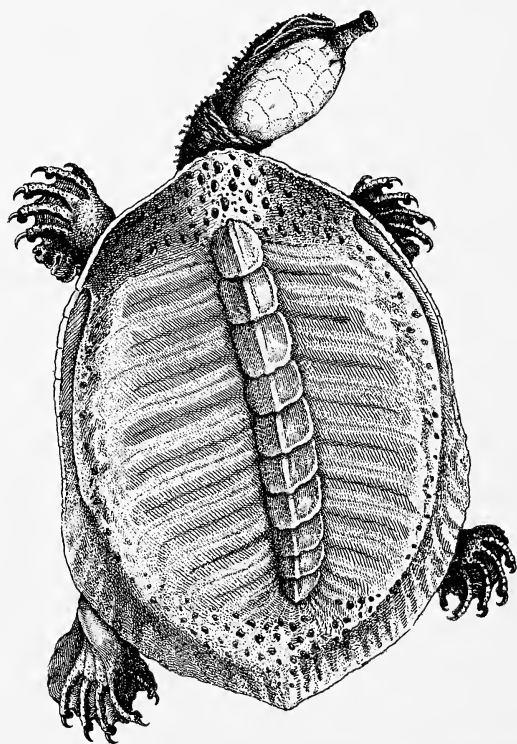
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G. B. S. engr.

## Franklinia

The franklinia or Franklin tree (*Franklinia alatamaha*) taken from The North American Sylva (vol. 2, pl. 59, 1818) of F. Andrew Michaux. After its original description, the franklinia was often considered to be a species of *Gordonia*, along with the loblolly bay (*G. lasianthus*) of our southern states. However, the unique structure of its capsule has prompted most modern taxonomists to classify it in a genus by itself.

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"Great soft-shelled tortoise" from William Bartram's Travels through North and South Carolina, Georgia, East and West Florida (1791).

## NOTES FROM THE ARNOLD ARBORETUM

"I am a plantsman!" With these four words, more apt than any of us could have imagined initially, Michael Albert Dirr bounded into Jamaica Plain in July, 1978, and into the hearts of all who would be associated with him during his twelve month appointment as a Mercer Fellow. The Arnold Arboretum will never be the same.

Mike squeezed more into his year than many of us manage in a lifetime. He taught classes, he lectured, he patiently answered plant questions by phone and by letter, he led tours, he captained our lunch-time football team, he wrote articles. And that was only a small part of his typical day. What he liked most to do was look at plants. What he liked secondmost to do was talk about plants — to any and all who would listen. Students in his classes came great distances and in inclement weather to walk the Arboretum grounds with him. His colleagues at the Arboretum and elsewhere were like elixir to him. Nothing stimulated him more than talking plants. Like all great teachers, though, he never pretended to know it all. "I have so much to learn!" he'd moan.

He was generous in his praise of others and in acknowledging their assistance. He was one of the best press agents the Arnold Arboretum ever had. He spoke constantly of it at meetings he attended and on his travels to nurseries and universities. Superlatives were a large part of his vocabulary; "outstanding" and "fantastic" were two of his favorites, and he used them liberally when describing the Arboretum. "We're so fortunate," he'd say. "Imagine, being among the few se-



lected to work at 'America's Greatest Garden'!" Indeed, those of us who had been here awhile and had tended perhaps to forget, suddenly saw the Arboretum with fresh new vision. Like Mike, we began to appreciate the wealth we had all around us.

Mike Dirr was beloved by everyone. He was always exactly what he appeared to be: a warm and generous man, a kind man, a very giving man. He loved people, and people responded to his attention and to his enormous sensitivity with an unparalleled enthusiasm of their own. Mike left in his wake a New England landscape littered with friends. Hyperbole? Yes. But Mike Dirr seems bigger than life sometimes.

We miss Mike Dirr and his family. But as sure as the buds swell and burst in the early spring, and new leaves unfold, and robins fly north again, we know that Mike will return. Boundless enthusiasm, an abiding love of plants and people (with plants, perhaps, holding the *slightest* edge!) and a heart big enough to enfold the world: this is how we tend to remember Mike Dirr.

MARGO WITTLAND REYNOLDS

Right: From *Crispijn vande Pas the Younger*, *Hortus floridus* (1614). Back cover: Photograph by Mary Rosenfeld.



*Next issue :*

The Director's Report

Notes from the Arnold Arboretum:

The Collections Policy of the Arnold Arboretum:

Taxa of Intraspecific Rank, and Cultivars





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# ARNOLDIA

*The Arnold Arboretum*

Vol. 39, No. 6

Nov./Dec. 1979

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\* Joint appointment by the Arnold Arboretum and the Gray Herbarium

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Front cover: A grove of white pines (*Pinus strobus*) on Bussey Hill.  
Photograph by P. Bruns.

# The Director's Report

THE ARNOLD ARBORETUM  
DURING THE FISCAL YEAR ENDED JUNE 30, 1979

The year past was an interregnum between two directorships. Dr. Richard A. Howard retired from administrative duties June 30, 1978, after twenty-four eventful years. Dr. Peter S. Ashton's arrival from the United Kingdom was delayed until December 28, 1978, by immigration formalities. In the interim, Drs. Bernice G. Schubert and Richard E. Weaver, Jr. acted as directors at Cambridge and Jamaica Plain, respectively. The Case Estates were without a supervisor the entire year, following the resignation of Kenneth Shaw in the previous fiscal year; James A. Burrows was appointed to replace him, starting in July 1979.

The second half of the fiscal year was a period of policy reassessment and definition. The new director, in a message to the readers of *Arnoldia* (March/April 1979, pp. 67-70), emphasized the need to harmonize, and, where possible, integrate the apparently disparate functions and facilities of the Arboretum, with its several commitments to the University and to the City, to research, education, and amenity, and to its facilities at Cambridge, Jamaica Plain, and Weston. The Arboretum has been and always will be in the first instance a University museum: a collection of living and preserved woody plant species which, with its libraries and in combination with the other University herbaria, provides Harvard with the outstanding facilities of their kind in the world for research and education. Only if it maintains its preeminence in research and education can the Arnold Arboretum continue to develop its complementary function

as a unique public amenity and an authoritative source for information on the culture of woody plants.

It is vital that our collections, in both the plantings and the herbaria, be actively used for research and instruction by Harvard faculty and students, preferably in combination. The association of a museum and a university provides each with strengths and opportunities greater than either alone could muster. This is obvious to those of us with experience in independent herbaria and botanic gardens. Interaction with faculty outside the Arboretum, and the participation of students can foster the vigorous and innovative climate required for research of the highest standards. At the same time, the unrivaled diversity of plant form available in our collections offers research and educational possibilities that no other university can match. Our future policy will be built on two independent convictions: first, that as part of the Institute of Plant Sciences, the Arboretum must pursue every opportunity to participate in and facilitate the work of the Department of Biology; and second, that research by faculty and students using the collections alone assures their continued curation and their future usefulness to the scientific community at large.

Styles, both aesthetic and scientific, change during the life of a tree. To establish a reputation for excellence, an arboretum must maintain a consistent planting policy. Charles S. Sargent was well aware of this need:

. . . In such a [tree] museum, every thing should be subservient to the collections, and the ease with which these can be reached and studied; and none of those considerations of mere landscape effect, which properly govern the laying out of ordinary public parks, should be allowed to interfere with these essential requirements of a scientific garden, however desirable such effects undoubtedly are.

The possibility of making a plan which should place every plant in the best position attainable for it, preserving at the same time for the whole collection, as nearly as practicable, the fixed sequence of arrangement, which alone makes large collections valuable for comparative study and possible to manage, was, then, the first thing to be considered. In connection with this, but subservient to it, it was necessary to devise a system of roads and walks which should make easily accessible to a large number of visitors every plant in the collection, and which, without interfering with the scientific necessities of arrangement, should open up and develop, as far as possible, the remarkable natural beauties of the ground.<sup>1</sup>

<sup>1</sup> C. S. Sargent, "The Arnold Arboretum", *Annual Reports of the President and Treasurer of Harvard College*. 1877-78.

. . . there is evidence that every aspect of the grounds has been the subject of careful study. . . . While the scientific side of the establishment necessarily dominates all others, the natural beauties of the site have not only been preserved but greatly enhanced.<sup>2</sup>

From the foregoing and other writings, it is clear that Sargent's aim was to establish a comprehensive collection of woody plants, arranged, for scientific and educational purposes, according to the natural classification of Bentham and Hooker and set in the landscape in such a way that it would become a public amenity of beauty. To insure the latter, Sargent collaborated with Frederick Law Olmsted in designing the paths and plantings. It also is clear that Sargent intended the principal and permanent plantings to be collected from the wild, and that their provenance and other details were to be recorded fully, and herbarium vouchers collected from the parent trees. Following Sargent's death, the standing collection was maintained, but there is no mention in reports of any policy for further accessions, or deaccessions, until after the second World War. By then the collection had been severely damaged by the storms and hurricanes of the thirties, and the shrub collections were overgrown through neglect.

In 1946, Dr. Karl Sax, then the director, asked Beatrix Farrand to make recommendations for restoring the collections. A landscape architect by training, her plan could not have been executed without the experienced presence of the Arboretum's horticulturist, Dr. Donald Wyman. Beatrix Farrand was well aware of Sargent's original policies. Her policy statement in *Arnoldia* (November 1, 1946, pp. 45-48) shows that she had a different problem to face owing to the senescent condition of some plantings, and to overcrowding. She felt that it was appropriate to chart a new direction:

Among many questions to be considered is whether the comparatively small acreage of the Arboretum can wisely accommodate all the species and varieties of woody plants of the temperate regions. If the acreage is thought too small for this full collection, a further decision should be made whether to limit the Arboretum collections or to provide a space for planting the material of comparatively limited interest which would overcrowd the present available area.

Old friends of the Arboretum may feel aggrieved in seeing some of the plantations altered, but they will be less distressed when they realize that these very alterations are absolutely essential. They are undertaken in order to re-

<sup>2</sup> W. J. Bean, "A Visit to the Arnold Arboretum", *Kew Bulletin*, 1910, no. 8, pp. 261-69.



store the design to essentials in the plant groups and also to display to advantage the best and most ornamental of the plants now growing within the Arboretum.

In the second quotation, "best" and "most ornamental" clearly are meant to be synonyms. How can a plant be assessed as "best" for science or education? Dr. Wyman executed the above policy with panache and considerable skill over the following fifteen years. His own report in *Arnoldia* (March 21, 1947, pp. 1-8) testifies to this:

. . . Since Professor Sargent's death, however, plants have continued to be sent to the Arboretum, new plants and some sent for "trial" to the extent of approximately 600 a year. Since the area (265 acres) has not been enlarged, and trial growing space had to be given for new and untried plants, the general plantings became more and more crowded, with the result that individual specimens received less care.

A combination of circumstances since the war has resulted in an increased emphasis on the horticultural activities of the Arboretum.

Certain varieties which have not proved themselves to be among the best of their group for ornamental purposes may be removed from the general collections at Jamaica Plain and grown on the Case Estates in Weston. Here such varieties, important for scientific reasons, would be lined out in rows and cultivated by machine at comparatively little expense. At Jamaica Plain, then, one would be able to see the most important plants and the best ornamental varieties in certain groups normally having a large number of varieties. In other words, as Mrs. Farrand has very rightly pointed out, it is impossible to continue to grow all the woody plants that are hardy in this climate on the 265 acres, especially if certain wooded areas and other important landscape features are to be maintained, as they should.

This winter, for instance, we were able to remove over 900 plants of 25 genera without eliminating any species or variety of importance.

According to recent calculations, it is possible to grow at Jamaica Plain up to three plants of every species of woody plant hardy in the West Roxbury area. The problem of overcrowding becomes acute when cultivars are introduced as a policy, for their numbers are potentially limitless. It is a reflection of past priorities that some of the plants transferred to permanent nursery rows at Weston were original Wilson introductions, that maintenance was very low, and that subsequently many plants there died.

Another of Sargent's policies is relevant in this context. He recognized the need for a dichotomy between the permanent "backbone" of the collection, consisting of trees and the shorter-lived shrub collections, and the experimental or ornamental material which could be regarded as more temporary and amenable to change. The post-war policy did not continue this distinction, and in several cases permanent plantings were removed for purely aesthetic reasons.

Sargent's accessions policy is precisely what a plant scientist at the present day, would advocate, perhaps more urgently, owing to the impending extinction of so many species in the wild, especially in East Asia. Cultivars, especially when grown in juxtaposition with their parents when known, have limited educational but usually no scientific or horticultural research interest. Postwar accessions policy has, therefore, been at the expense of the scientific value of the Arboretum.

Seth Kelsey, a horticulturist who advised on accessions policies for

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#### FREDERICK LAW OLMSTED'S PLANS

Right: Between 1879 and 1886 Frederick Law Olmsted produced approximately eighteen to twenty studies or plans, described by him as "distribution studies", concerning the arrangement of plant families within the Arboretum. These plans depict the design process by which Olmsted located plant families in the succession accorded them by the Bentham and Hooker classification system along his projected layout of roads and paths. The distribution of plant families and the layout of the roads and paths were interdependent and incorporated a keen awareness of the natural topography of the Arboretum. The plan at right (No. 24, August 29, 1885), one of the last in the series, shows the roads as they appear today, with the exception of the summit of Bussey Hill (area 14, 15) and the beginning spur of a road that was to ascend Hemlock Hill (area 18, 19). Until 1895 the City of Boston retained the summit of Bussey Hill as a reservation, including the area often referred to as the "overlook". This prevented extensive planting until later in the Arboretum's development. The road to the summit of Hemlock Hill, although planned in detail, was never undertaken; a path follows closely the original road design. Olmsted's earlier studies show the roads bisecting each plant family. This proved impractical because the design required an excessively long, winding road system. Succeeding studies show the road shortened, with the plant families staggered one after another on each side of the road. The Park Department began work on the roads in 1883 and finished in 1892. Each segment of the road system was named. Valley Road (1884), which extended from the Center Street (Route 1) Gate to the South Street Gate, was the first road completed, and the earliest plantings of the permanent arrangement of plant families were laid out along its borders. This meant siting families which are listed by Bentham and Hooker two thirds of the way through their natural sequence. The families planted were: *Platanaceae*, the plane trees; *Juglandaceae*, the hickories, walnuts, and wingnuts; and the *Fagaceae*, the oaks, beeches, and chestnuts. One example of how spatial requirements were ascertained for individual genera can be noted with the wingnuts, *Pterocarya*; with only two known species at the time, the genus was allotted a small area. The need for a multitude of distribution studies can be appreciated when the number and diversity of plant material which had to be included are considered.





Top: A section of Oak Path in 1913. The path system was designed to allow more intimate visitor access to the collections than was possible on the roadways. All the paths were mowed, as shown here. Oak Path leads through the largest and one of the oldest of the original plantings. Here Sargent's "groups" or groves of trees of a single species were most highly developed. Photograph by T. E. Marr & Son. Bottom left: The upper part of Oak Path in 1903, with a large specimen of white oak (*Quercus alba*) in the middle background. Photograph by T. E. Marr. Bottom right: Oak Path today, with the same white oak shown at left. The path and its surroundings have been greatly altered since the days of Sargent and Olmsted. The oaks have been thinned and only remnants of Sargent's "groups" are evident. The trees have been underplanted with masses of azaleas, primarily color variations of our native flame azalea (*Rhododendron calendulaceum*). The lower part of the path, from its entrance on Valley Road in the Walnut Collection, has been obscured. The grass will be allowed to grow in this area and meadow wildflowers will be planted. The path will be merely mowed here and in the lower part of the Oak Collection to a point where the path begins to be bordered by azaleas; from this point the path will be surfaced with a natural material. The regrading has already begun, as can be seen in this photograph. Photograph by S. Geary.

the Horticultural Subcommittee of the Visiting Committee in 1970, argued in his report that:

Since . . . the Arboretum is a park as well, and open to the public as such, a continuing objective should be to *improve the landscape appearance of the collections for increased public enjoyment and education*, and perhaps the time has come for a complete restudy of the Arboretum from the landscape and display point of view.

He recommended

. . . an active program of breeding and selection to develop cultivars of (a) greater ornamental value, (b) increased hardiness, (c) greater resistance to insects and disease, (d) greater tolerance to urban conditions, including but not limited to factors of pollution.

By intensive and skillful field work many decades of labor can be saved and much more immediate results can be achieved for the benefit of the public and the renown of the Arboretum. Several years of intensive summer field work on city streets followed by limited propagation and testing at Weston of the superior clones uncovered, would yield relatively quick and very important results. The Arboretum has the required room and facilities, and probably the staff to carry out such a program.

A comprehensive collection of species acquired from the wild, precisely the sort of collection Sargent envisioned, would provide an unparalleled base for the kind of research Seth Kelsey recommended. Kelsey did not state how continued accessions of cultivars, often of unclear parentage, into the permanent collections would benefit such a program. He did recommend, in a special report to the director, dated May 1, 1965, the planting of additional species, but went on to recommend nurseries from which stock could be bought. Nursery stock, generally of unknown provenance and parentage, is of limited potential for research.

Seth Kelsey's recommendations illustrate a difference of views that has arisen between plant scientists and amenity horticulturists. The Arnold Arboretum, as part of Harvard University and alone among institutions of its kind, has the capability — and, we would say, its primary function — to support research, and thereby to promote those educational opportunities that arise from research, of the highest level of scientific excellence. We mean fundamental research, descriptive or experimental, aimed at increasing our understanding of the diversity of plant form and function; for example, research on the hormonal physiology of woody plant roots, on tree breeding systems, in population genetics, or in systematics. Such research can be instrumental as well in advancing horticultural science by extend-

ing our knowledge of plant diversity, breeding, and propagation. Plant breeding programs, on the other hand, usually rely on established knowledge and techniques and do not require the full-time assistance of theoretical scientists. I am not suggesting, I wish to emphasize, that Arboretum staff should not pursue horticultural research. Rather, the living collections will always need curatorial staff, and staff members with curatorial functions should be expected to pursue research into plant breeding and other horticultural fields, as they have done so well in the past. Our academic staff members (faculty) will wish, rightly, to concentrate their efforts in fundamental scientific research. Both groups should work in close collaboration. Thus our horticultural endeavors will profit directly from the work of our faculty.

We are of the opinion that a clash of interests between horticulturists and plant biologists is as unnecessary as it is undesirable, and believe that it has arisen, in part, through lack of adequate communication. It should be recalled that from the beginning Sargent faced the problem of serving the needs of science, education, and amenity, and solved it. His employment of Olmsted as his landscape architect led to the creation of a unique, public, work of art, now the only remaining working arboretum designed by that landscaping genius, and the one on which he lavished the most time. Olmsted's planting design emphasized the landscape as a whole, not the display of individual specimens. Consequently, his design has been obscured by the very horticultural plantings meant to enhance the Arboretum's beauty! As I have explained, we cannot do better for science, for horticulture, for conservation, or for amenity, than to revert to Sargent's accessions policy. We have room in Jamaica Plain for all the hardy woody plant species; we can and should retain in Jamaica Plain, on a less permanent basis, selected cultivars of outstanding historical or display value when they enhance the landscape as a whole. This allows us to develop a discrete, yet interrelated, policy for the Case Estates; there alone is the room we will need for horticultural and botanical experiments, and there, too, a more extensive collection of outstanding cultivars can be grown for assessment and display.

Three policy decisions have already been made in this spirit. With the objective of achieving a completely documented collection in Jamaica Plain of woody plant species hardy in that area, a decision has been made to seek grants for a complete restoration of the living collections there over a period of five years. This would involve verifying the identification of the plants, checking their labels and the records that need to be computerized, and preparing a new map, which also will be used as the basis for a guidebook. The restoration will enable us to define precisely, and for the first time, the gaps that need to be filled, and, hence, our future accessions policy. Concurrently, we intend to restore Olmsted and Sargent's planting plan for



Top: The Bussey Hill Overlook in 1904, nine years after it ceased to be a reservation of the City of Boston, but before development by the Arboretum. The vista toward the Blue Hills to the south has always been one of the finest in the Arboretum. Storms have taken their toll of the sentinel group of white pines in the photograph, and only one remains. Photograph by T. E. Marr. Bottom: The Bussey Hill Overlook as it appears from the recently renovated sitting area at the top of the hill. Although much of the original field still remains, it has been encroached upon by various plantings, notably the *Cytisus* and *Cotoneaster* beds at the right of the photograph and the so-called Chinese Walk, which more or less encircles the field. Azalea Walk, constructed along the western edge of the field shortly after the Arboretum gained control of Bussey Hill, has been largely obscured by these same plantings. Due to a need for planting space, the field will not be enlarged to its former proportions, but the present beds will be consolidated by relocation of the *Cytisus* and *Cotoneaster* Collections. Azalea Walk will be restored as the primary collection of Asiatic azaleas. The Chinese Walk will be expanded primarily under the trees on the eastern side of the field. Photograph by S. Geary.



that part of the Arboretum designed by them, and to produce for the remaining parts in Jamaica Plain a long-term plan for including, in a manner convenient for scientific and educational purposes and in the spirit of the Olmsted-Sargent plan, the many species discovered in the last hundred years.

Secondly, we plan to integrate more closely than at present the work of the propagation and nursery facilities at Jamaica Plain and at the Case Estates, and to develop scientific research based on the living collections. At the same time we wish to encourage more horticultural research by our curatorial staff. A first step has been the approval of a new professorial appointment in the root biology of woody plants, to be based at the greenhouse facilities. This appointment was included in the 1979–80 budget, and the person appointed, it is hoped, may also fill the role of deputy director.

Thirdly, we intend to complete our collections by acquiring plants from the wild, both through exchange and through expeditions organized by ourselves or by others. Our North American holdings are far from adequate. I shall be reporting on two staff collecting trips which made a start toward correcting this situation.

The herbarium of the Arnold Arboretum, through the policies for the living collections described above, once again will be an integral part of a facility for the study of woody plants that probably is unsurpassed anywhere. It is timely that the Harvard University Herbaria Building is being expanded to provide fifty per cent more space for our collections, and additional office and laboratory space for staff. This extension is currently scheduled for completion in early 1980.

The National Science Foundation Curatorial Grant for the combined herbaria presupposes a reinvigoration of botanical research based on their collections. The herbarium of the Arnold Arboretum, in combination with the library, provides the foremost facility in the Americas for the study of the botany of the Far East, both temperate and tropical, and plants from this region are particularly well represented in our living collections. Of special significance to us, therefore, was a visit to Harvard in May 1979 by a delegation of botanists from the People's Republic of China, the first delegation of botanists to visit the United States since the revolution. I shall be reporting subsequent events which give us grounds for hope that collaboration in research will be renewed. Similarly, at a symposium in Malaysia the director discussed future collaboration in research and training with colleagues in that region.

The Arnold Arboretum is perhaps the foremost amenity that Harvard offers to the Boston public. We can provide this service as a natural extension of our university function: our extensive and well-maintained collection of woody plants, located on an attractive site of rolling land, and laid out and provided with a system of roads by Frederick Law Olmsted, will be valued increasingly as a quiet and



Above: A view taken in June 1908 of the lower section of Bussey Brook Valley with the mountain laurels (*Kalmia latifolia*) in full bloom. For many years the grass in the Arnold Arboretum was not mowed regularly, and native wildflowers, such as the Black-eyed-Susans seen here, provided a display spectacular enough to prompt the following comment from W. J. Bean of the Royal Botanic Gardens, Kew:

Another beautiful feature of the Arboretum, and one which makes a special appeal to the foreigner, is the native undergrowth. In place of the lawns and grass which cover so much of the ground in English gardens and parks, there is here a very interesting ground-covering consisting of native plants, amongst which are various species of *Vaccinium*, *Aster*, *Rubus*, golden rod and *Asclepias*, *Baptisia tinctoria*, sweet fern and the poison ivy.

(Bean, W. J. 1910. A visit to the Arnold Arboretum. Kew Bull. Misc. Infor. 1910: 261-269.) Photograph by T. E. Marr.



Left: A view of Bussey Brook Valley today. Only a narrow strip of native vegetation on each side of the brook is allowed to grow. The remainder of the meadow is mowed regularly and has become turf. As part of the projected restoration of the Arnold Arboretum, the grass and wildflowers will again be allowed to grow in the lower part of Bussey Brook Valley and in a few other selected areas. The spontaneous flora will be supplemented by other native species of meadow plants to increase the diversity for educational purposes. Photograph by S. Geary.

tranquil refuge as travel becomes more expensive. The Southwest Corridor Project, involving the construction of a new subway beneath a corridor of parkland from central Boston to Forest Hills, brings a further responsibility to the Boston public, but also an opportunity to expand our public services. I shall be reporting on the initial steps we have taken to seize this opportunity. The various functions of the Arboretum depend on a high level of upkeep and control of vandalism. Both are improving, thanks to steps which have been taken in recent years.

Essential to future policy will be a staff structure that can implement it. In a series of meetings in February and March 1979 a new staff organization was devised. Its aim is to establish clear lines of responsibility, to increase the extent to which responsibility is shared, to increase communications between the various parts of the Arboretum, to facilitate future planning, notably through identification of gaps in staff, and to integrate our work more clearly and advantageously with that of the other institutions associated with the Department of Biology. The work of the Arboretum has been divided into five functions, with five committees to define policy. Three of these committees, the Herbarium Committee, the Library Committee, and the new Publications Committee are constituted jointly with other Harvard herbaria. The two other committees are the Living Collections Committee, and the Public Relations and Education Committee. The director is an ex-officio member of every committee, as will be the deputy director when appointed. Other scientific staff members may be appointed to committees, but in any case have the right to attend any committee meetings and thereby are encouraged to participate in policy making. The senior member of the executive staff concerned with each of the five functions chairs the appropriate committee and is responsible for the implementation of its decisions; other executive staff members under his or her direction serve on the committee. Each committee should also include one invited member from outside the Arboretum.

The final resolution of the fate of the Adams-Nervine property, mentioned in previous reports, awaited the new director on his arrival. Reassessment of the cost of acquisition and restoration of some of the buildings indicated that this would be an investment of doubtful value. Fortunately, the property has been acquired by a development company which intends to convert the existing buildings into condominiums without significantly altering their external appearance.

Robert G. Williams, superintendent of the Arboretum, Jamaica Plain, since 1945, retired at the end of the fiscal year. Serving under four of the Arboretum's five directors, Robert Williams established a high standard of maintenance of the living collections through strong and just administration of the grounds staff, and thrifty and careful exploitation of the available facilities. His successor is Henry

Stanton Goodell, who this year received his commendation from Harvard for twenty-five years of meritorious service.

### THE LIVING COLLECTIONS

The Living Collections Committee, under the chairmanship of Gary Koller, the supervisor of the living collections, addressed itself to the definition of a long-term accessions and deaccessions policy. The committee having agreed that Sargent's original policy remains appropriate for the purposes of the Arboretum, preliminary investigations of this policy led to the rediscovery, at the offices of Olmsted Associates in Brookline, Massachusetts, of Olmsted's original plans for the main eastern section of the Arboretum. No copy of these plans existed in our archives. The plans showed that Olmsted and Sargent's planting and layout have survived to a remarkable extent. The Living Collections Committee resolved, therefore, to restore the Olmsted-Sargent plan, both as a work of art and, to the extent feasible, as a scientific collection; to incorporate the shrub collections with the original plan; and to develop the Peters' Hill and South Street tracts in the spirit of Olmsted's plan, accommodating the many exotic species discovered since his time. This project will take years to accomplish. As mentioned earlier, it will involve reorganization of the record system, verification of plant identifications, and remapping. Grant proposals for the restoration will be submitted in the coming fiscal year. For the present, the Living Collections Committee has clarified accessions and deaccessions policy, and thus provided the basis for closer integration of our propagation and nursery facilities at Jamaica Plain and at Weston in preparation for the arrival of a new supervisor at the Case Estates.

Of great moment to the Arboretum is the news that the Southwest Corridor Project is to go ahead and is given a high priority by the Governor. Arboretum staff members have been attending community meetings, and the director and the supervisor of the living collections have had discussions with the project director and the director of forests and parks at the Department of Environmental Management. The Forest Hills Station is to be moved further to the north, and therefore closer to the Arboretum. We expect that our main visitor flow in the future will be to and from this station. Therefore, we need to develop, in cooperation with the Southwest Corridor authorities, an integrated plan for a new access route into the Arboretum, possibly by way of the South Street tract. A visitor center at the new entrance is being considered. We have agreed to collaborate in providing an exhibit and planting at the new station, and to advise on plantings throughout the Corridor.

Two Mercer Fellows were appointed during the year. Mohammed Jadidi, from Ariamehr Botanical Garden, Tehran, Iran, received training in arboretum operations under Dr. Richard E. Weaver's super-

vision during the period July 1 to November 15, 1978. Dr. Michael Dirr, from the University of Illinois, Champaign-Urbana spent the entire year at the Arboretum, during which time he prepared three articles for *Arnoldia*, one of which, "Street Trees for Home and Municipal Landscapes", coauthored with Gary Koller, has been reprinted as a handbook. He gave two lectures within Harvard, and numerous others in Boston and elsewhere.

Two collecting expeditions within North America were mounted by Arboretum staff members during their vacations. Robert Nicholson made a carefully planned visit to British Columbia in the fall of 1978, bringing back 124 collections representing 110 taxa from thirteen locations in the wild. A special effort was made to collect seed from the points of maximum hardness of species ranges. Dr. Weaver visited the Southeast in April 1979 and collected forty-seven young plants, of which all but two have survived. Altogether 178 shipments of plants and propagation material representing 976 taxa were received during the year from twenty-seven countries. Notable among these were nine shipments from the People's Republic of China representing 138 taxa.

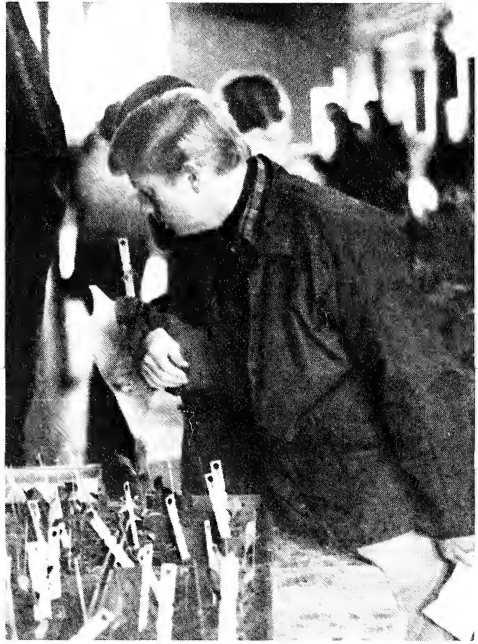
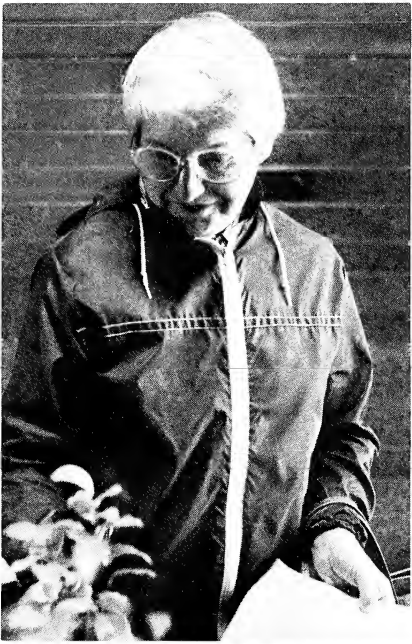
Two hundred fifty-five taxa were propagated to provide replacements for defective specimens in the Arboretum. In addition 158 taxa were propagated in response to requests and in anticipation of our distribution program.

Some 4,000 plants of 117 taxa from Dr. Stephen Spongberg and Dr. Richard E. Weaver's 1978 Japan/Korea expedition were distributed to eighty-five institutions in six countries. Further, 210 shipments, comprising 1,123 taxa, were distributed to cooperating institutions, nurseries, and individuals in eighteen countries. *Magnolia sieboldii* var. *sieboldii* seedlings were sent to fifty-five members of the American Magnolia Society. *Hovenia dulcis* seed was distributed to eighty-nine individuals and institutions. Cuttings of over fifty taxa were made available to nurserymen at a professional propagators' workshop conducted by Gary Koller and John Alexander. Over 800 seedlings and rooted cuttings of sixty taxa were distributed at the Case Estates to more than 180 members of the Friends of the Arnold Arboretum.

Princeton Nurseries, Princeton, New Jersey, and Weston Nurseries, Hopkinton, Massachusetts, made notable donations of plant material. Many of these taxa were used as understock.

Donna Lynch, mapper and labeler, resigned in September 1978, and her work was discontinued until March 1979, when Jennifer Hicks assumed this position. Meanwhile, Charles Mackey checked collections over a large portion of the Arboretum for missing labels. Scientific and display labels have been prepared as needed. As these are put out, the maps of the Arboretum collections are updated. A new map of the dwarf conifer area was completed in April 1979.

The weather during this fiscal year has been unexceptional, apart



*Each autumn at the Case Estates in Weston the Arboretum holds a plant distribution for members of the Friends of the Arnold Arboretum. Members must come in person to select their plants on that day. For many the biggest difficulty in making their selection is the large number of different and unusual plants offered.*



from the very low snowfall, 23 inches in comparison with 80 inches the previous year. The Arboretum has been in better condition this year than some years past, with grass well cut, and with considerably less litter. This has been due largely to the efficient deployment of the grounds staff by the assistant superintendent, Henry Goodell. As mentioned earlier, at the end of the current fiscal year he was promoted to superintendent on Robert Williams's retirement. Also, in part, the better condition of the grounds is thanks to a new joint initiative with our neighbors and Friends, twenty of whom joined us for a spring cleanup in April, a very successful venture that we hope to repeat twice yearly in the future. Although a fire in the spring of 1979 burned about a third of the turf on Peters' Hill, and we have been involuntary hosts for numerous teenage beer parties, vandalism in general has declined, thanks to greater police surveillance. The mounted police also have visited the Arboretum more frequently than heretofore. The director visited Police Station Thirteen early in the year for discussions with Captain Caselli, and attended a meeting, convened by the local community, to discuss vandalism in the Arboretum. These meetings, and the maintenance of close contact with the police and Police Commissioner Jordan's office, appear to have had a marked positive effect.

A new barrier was installed at the Peters' Hill gate on Bussey Street, and has reduced the entry of stolen cars.

James Burrows, who resigned as assistant propagator in February to take up a post in Korea, returned, and has been appointed assistant supervisor of the living collections, assigned to the Case Estates, beginning in July. An agreement with the Massachusetts Rhododendron Society, signed in February, for a display bed at the Case Estates, represents a start to our policy of establishing collections in Weston of outstanding horticultural cultivars.

In addition to the personnel changes mentioned, grounds staff member Alphonse MacNeil retired, Angilo Navarro resigned, and one grounds staff member was dismissed. Mark Walkama was appointed a pruner in Jamaica Plain, and Bruce Munch joined the grounds staff at the Case Estates. Peter Del Tredici was appointed assistant propagator, and Jeanne Sattely replaced Jennifer Hicks as horticultural secretary.

Twenty-one horticultural trainees were employed in 1979, fourteen of whom were local residents.

Improvements to the collections included consolidation of several beds in the deciduous *Rhododendron* (Azalea) border; restoration of the hedge collection, including construction of a walk to the dwarf conifer collection; major removal of surplus and overgrown stock in the old conifer garden, the *Taxus* collection, the collections abutting the South Street gate, the *Ilex* bed, and the *Fagus* collection; repair of drains underlying the *Carpinus* and *Aesculus* collections; and major pruning of the *Ulmus* collection, in which five cultivars of *U. ameri-*



*cana* have become infected by Dutch elm disease. Dr. Weaver, horticultural taxonomist, checked the identity of the *Cytisus*, *Maackia*, *Corylus*, and, with the assistance of volunteer Dr. Richard Warren, the *Abies*, *Pinus*, and *Larix* collections. Dr. Weaver is currently checking the greenhouse and nursery holdings, and marking seedlings in the greenhouses for habit and hardiness before they are transported to the saran house.

One hundred forty-five plants, representing seventy-three taxa, were added to the permanent collections this year. Thirteen of these taxa were new to the Arboretum, five were cultivars, and seventeen were collected from wild stock. Twelve plants were replacements.

Major repairs were made to the chain link fence on behalf of the City, following damage caused by the blizzard of 1978. Leaks in the heating system of the Administration Building were detected and repaired, and the roof deck of the Dana Greenhouses was reconditioned.

Dr. Spongberg continues to serve as chairman of the Registration Committee of the American Association of Botanical Gardens and Arboreta (AABGA), and has recently been co-opted onto a subcommittee of the Botanical Society of America charged to develop collaboration with the People's Republic of China.

Gary Koller, supervisor of the living collections, helped to organize the North Atlantic Regional Meeting of the AABGA in February 1979 at Old Sturbridge Village, and attended the National Meeting of the American Holly Society, and the Massachusetts Horticultural Congress. He lectured at fifteen professional and amateur horticultural meetings. Also, he was judge for amateur horticulture for the New England Spring Garden and Flower Show. He is on the Boards of Trustees of the New England Wildflower Society and the Jamaica Hills Association, the Living Plant Collections and Membership Committees of the AABGA, and the Garden Committees of the Garden In The Woods, Trustees of Reservations, and Old Sturbridge Village.

John Alexander, propagator, gave a lecture at the International Plant Propagator Eastern Region Convention in Toronto in December 1978; he ran a workshop at the June meeting of the International Lilac Society, of which he has been elected a director; and he was an examiner at Longwood Gardens, Kennett Square, Pennsylvania for the AABGA North American Certificate in Gardening. Also, he is co-chairman of the Plant Production Subcommittee of the Massachusetts Chapter of the American Rhododendron Society. Together with Gary Koller, he conducted a workshop at the spring 1979 meeting of the American Rock Garden Society. He and Gary Koller also conducted an all-day propagation workshop for plant professionals, attended by twenty-two people from five states, in July 1978.

#### THE HERBARIUM

Dr. Norton G. Miller, associate professor and associate curator,

continued as chairman of the Herbarium Committee. During the year, Carolyn Hesterberg resigned as herbarium secretary, and was replaced by Rita Silverman.

The herbaria and libraries of the Arnold Arboretum and the Gray Herbarium are particularly strong in materials for the study of North American plants, and the floras of the temperate and tropical Far East. The library and herbarium of the Arboretum in Jamaica Plain is especially rich in materials for the study of cultivated plants. The research interests of our staff reflect these strengths, and depend heavily on thorough and continued curation of the herbaria. During the year, Elmer Drew Merrill's collections of type fragments, which he obtained from European herbaria, and which constitute a valuable taxonomic tool, were curated, and now are ready to be mounted, annotated, and inserted. These latter tasks have already been completed for Symplocaceae, Myrtaceae, Myrsinaceae, *Ficus*, *Ericaceae*, and *Elaeocarpaceae*. The Arboretum file of photographic negatives of type and other authentic specimens has now been fully integrated with that of the Gray Herbarium. This involved indexing 5,060 negatives or negative strips. Folders for type specimens were replaced and added in 29 families, and New World geographic tags were provided for 105 families.

Our holdings of *Osmoxylon*, *Boerlagiodendron*, Old World Balanophoraceae and Bignoniaceae, *Elaeocarpaceae*, *Ficus*, and twelve other, small taxa have been annotated and reorganized according to recently published treatments. Between one-third and one-half of the collections were in need of annotation, including some 1,000 sheets of *Ficus* and 1,289 of *Elaeocarpaceae*.

The total number of sheets in the Arnold Arboretum herbarium at Cambridge at the end of the fiscal year was 1,091,886; 12,575 sheets were mounted and incorporated, 86 were removed, and 9 previously mounted specimens were added directly. In the cultivated plant herbarium in Jamaica Plain there are 167,238 sheets, of which 2,263 were additions this year. One hundred eight sheets in the two herbaria were repaired. Of the 7,557 accessions in the two collections, 4,375 were received by exchange, 101 by special exchange, 2,217 by gift, 604 by subsidy, and 260 for identification. The principal provenances were Western Malesia (2,264), Papuasias (1,401), East Asia (756), Australia (595), and the West Indies (572). The total number of specimens sent on exchange was 527. During the year, 65 loans, totaling 4,946 specimens, were received for study by staff members; and 25 loans, totaling 2,081 specimens, were received for study by students; while 261 loans, totaling 30,934 specimens, were sent out.

For the first time, the combined herbaria hired work-study students to assist in curation; both were Harvard students who had taken Biology 18, Diversity in the Plant Kingdom.

The construction of the addition to the Harvard University Herbaria Building is running behind schedule, but should be completed

during the coming year. It will have twelve herbarium rooms with two compactor banks each, eleven of the rooms to house the Arnold Arboretum and Gray Herbarium collections, and one to house the Orchid Herbarium of Oakes Ames. Fortunately, it was possible, by financial readjustment, to acquire all twenty-four compactors required, notwithstanding forewarnings to the contrary in the last annual report. One demonstration compactor has been installed for inspection; certain operational defects have been identified, and are being corrected. Specimens stored in the basement work area are being temporarily relocated to other parts of the building so that good cabinets from elsewhere in the building can replace the tin-covered wood cabinets previously in the basement.

About 100 photographs were taken with the M.P.-4 camera of specimens being added to the combined herbaria or to the herbarium at the Botanical Museum. The camera also received considerable use by individual staff members and by students. Photographs of our specimens, mostly types in ten genera, were sent on request to botanists throughout the world.

The herbaria received 203 professional visitors during the fiscal year.

The Seventh Annual Meeting of the Association of Systematics Collections was held at the Harvard Museums at the end of April 1979; Dr. Norton A. Miller and Dr. Carroll E. Wood were on the organizational committee, and the director presented the opening address.

### THE LIBRARIES

The Library Committee is chaired by Lenore Dickinson, librarian.

At the close of the fiscal year, the total number of books and pamphlets in the libraries in Cambridge and Jamaica Plain was 87,027; 727 were additions, 470 by cataloguing and 257 by binding. Of the additions, 137 were gifts.

In January 1978 the University Library Systems Office began its Monograph Cataloguing Support System (MCSS), under which individual libraries in the University Library System request searches of the Ohio College Library Center (OCLC) data base. Every book coming into the Arboretum and herbaria libraries is searched on the OCLC data base unless the libraries already have cataloguing for the piece. The percentage of titles found on the data base has been between sixty and seventy per cent of the searches submitted; the libraries receive full catalogue card sets from OCLC for books found on their data base. The use of MCSS has meant that cataloguing has become current with receipts. Some 200 titles remaining in the backlog were given temporary cataloguing, and are being searched for the second time on the OCLC data base. Titles not found in this second search will be searched in the National Union Catalogue; when necessary,

they will be given original cataloguing. As in the past, works in non-Western languages are catalogued for the libraries by the Harvard-Yenching Library, and works in Slavic languages are catalogued by the staff of the Slavic Department of the Harvard College Library. The exchange program maintained by the Slavic Department is the source for the Arboretum and herbaria libraries of many titles in botany, forestry, and related fields.

A shelf-reading project was begun in the herbaria libraries to account for the books which appeared to be missing. During a two-month period, the shelf reading showed that most of the missing books were in fact misshelved; others were mislabeled, or were labeled differently on the shelf card and on the main catalogue card. These discrepancies are being corrected. The results of shelf reading in our libraries closely parallel the results of a study at Widener Library of the Harvard College Library of a sample of "missing" books. In Jamaica Plain, main cards are being duplicated to create a shelf list for books added to the collection before 1975. When the card duplicating is completed, shelf reading will begin.

The book collection on the third floor in Jamaica Plain has been surveyed, and books requiring leather preservation have been treated by a team of volunteers. Books which need repair or rebinding have been recorded, and have been or will be sent to the bindery.

NSF Curatorial Grant supported rebinding or preparation of boxes for three titles in the Arnold Arboretum library. Charles Long, director of the library and plant information services of the New York Botanical Garden arranged for \$250 from the Taxonomic Literature II Project to be paid to the Arnold Arboretum and the Gray Herbarium for the repair or rebinding of books photocopied by the Taxonomic Literature II Team.

Under the Strengthening Research Libraries Program provided by Title II-C of the Higher Education Act of 1965, the University has received a second grant for microfilming rare or deteriorating library material. Under this project a master negative is stored under climate-controlled conditions by the Photoduplication Department in Lamont Library of the Harvard College Library, and is used to produce copy or film on demand. The owning library receives a positive film for use or for lending, thus assuring access to the material while preserving the original for future use. An alphabetical list of plants which were growing in the botanical garden of the Atkins Institution of the Arnold Arboretum, at Soledad, north of Cienfuegos, Cuba, is now being microfilmed. The Charles Sprague Sargent correspondence file has been nominated for microfilming.

Four quarterly accessions lists were prepared during the past fiscal year. A one-page handout was prepared to assist users in finding journals in the Cambridge and Jamaica Plain libraries.

Two hundred thirty-one requests for loans or photocopies were received and filled; fifty-one requests were sent out.

The Arnold Arboretum and herbaria libraries are intended for research, and never have been generally accessible to students other than Harvard graduate students in botany. In meetings between the Library Committee and the directors of the Arnold Arboretum and the Gray Herbarium, a library privileges policy for the herbaria libraries was devised which would limit access to members of the Harvard community and legitimate visitors. One hundred seventy-seven visitors registered to use the library in the Herbaria Building. A method is being devised to register persons who use the library in Jamaica Plain; our Friends will continue to have privilege of access.

The Herbaria Building extension will provide the herbaria libraries additional stack space on the second floor. One wall in the library staff work area will be removed to create a single, large space, allowing periodical check-in, bindery preparation, and processing for the shelves to be carried on in a logical sequence, and producing a more efficient work flow and a saving of time for each function.

Upon the occasion of the visit of a delegation of botanists from the People's Republic of China, the library mounted an exhibit illustrating the scientific links between the Arnold Arboretum and China. The botanical history of *Gleditsia sinensis*, a species introduced into cultivation in the United States by the Arnold Arboretum, was followed briefly through the literature, and displayed in publications and herbarium specimens. A description in *Kiu huang pen ts'ao*, with a woodcut dating from the fourteenth century, was kindly lent by the Harvard-Yenching Library. Publications of Arnold Arboretum staff members were displayed, as well as publications by Chinese botanists who had worked or studied in the Arnold Arboretum or in one of the other botanical institutions of Harvard University. The exhibit continued through the meetings of the Visiting Committee.

In March 1979 Sheila Geary, assistant librarian at Jamaica Plain, completed a 208 page report on an in-person survey during May 1977 of 300 casual visitors to the living collections in Jamaica Plain, and a mail survey in May 1978 of the membership of the Friends of the Arnold Arboretum. A summary of the survey of casual visitors was given in the 1976-77 director's report (*Arnoldia*, November/December 1977, p. 254). For the second survey 1,865 questionnaires were mailed, and 792 or 42% were returned. The results of the Friends survey have been incorporated not only in the planning of future Friends activities, but have been suggestive for our efforts to improve our publications, our education program, and our public relations.

Sheila Geary and volunteer June Hutchinson researched for the Living Collections Committee the original plans of the Arnold Arboretum at Olmsted Associates, and the planting policies of Charles Sprague Sargent and subsequent directors. Some of the results of the latter research appear in the opening statement of this report.

The librarian attended the Annual Meeting of the Council on Botanical and Horticultural Libraries, held at the Landscape

Arboretum in Minnesota. Until May 30, 1979, she was a member of the Subcommittee on Bibliographic Standards of the Harvard University Union Catalogue Planning Committee.

Jeanne Stevens, bindery assistant in the herbaria libraries, attended a two-day workshop conducted by Doris Freitag, book conservator in the Harvard University Library.

Volunteers continued to assist projects in the Arnold Arboretum libraries. Albert Thompson and Lou Segel carried out the leather-preservation treatments. Barbara O'Connor assisted in the Council on Botanical and Horticultural Libraries's survey of holdings of nursery catalogues. Volunteers Gertrude Cronk and Janet Thompson organized the nursery catalogue collection.

Marjorie Lewis, summer horticultural trainee, assisted in the library at Jamaica Plain.

Mark Belson, inter-library loan assistant, resigned in January 1979, and Jill Skarstad, library assistant, resigned as of June 30, 1979.

## RESEARCH

The Far East possesses an exceptionally rich flora, and one of special interest to the botanist, evolutionist, and horticulturist. As the institution with the preeminent facilities in the Americas for study of the flora of the Far East, we have great opportunities and a special responsibility to pursue research in and train students from that region. We hope our renewed contacts with botanists in the People's Republic of China will augment our research opportunities in temperate Asia; they could prove invaluable to Dr. Steven Spongberg's research into the temperate Asian woody flora, necessary for his critical revision of Rehder's *Manual of Cultivated Trees and Shrubs*.

The forests of the Far Eastern tropics are currently the principal suppliers of hardwoods to the United States, and indeed to the industrial world as a whole, and as a consequence are expected to be reduced to small fragments within fifteen years. The director and Dr. Peter Stevens are planning a program of collaboration with colleagues in the Asian tropics with whom they have worked individually in the past. This collaboration promises excellent future opportunities for our students.

The director worked toward completion of a taxonomic monograph of the major tree family Dipterocarpaceae. With Dr. Bassett Maguire, Senior Scientist of the New York Botanical Garden, he prepared a further paper on the newly discovered South American dipterocarp subfamily Pakaraimoideae. Also, he continued preparation of papers for publication on the stand structure of the famed double coconut palm of the Seychelles, on the biogeography of Ceylon, and on the ecology of bat pollination. He presented papers at the International Symposium on Tropical Botany at Aarhus University, Denmark, in



During May 1979 a delegation of botanists from the People's Republic of China visited botanical facilities across the United States. The Arnold Arboretum was fortunate enough to help host the delegation while they were at Harvard, and they visited our Jamaica Plain facility on the afternoon of May 8. Top: Peter Shaw Ashton greeting Wu Cheng-yi (center), Director of the Kunming Botany Institute, and Yu Te-tsun (far right), Deputy Director of the Botany Institute, Academia Sinica. Bottom left: Richard A. Howard and Lily M. Perry (back to camera) at lunch with Yin Hung-chang, Director of the Shanghai Plant Physiology Institute. Bottom right: Gary L. Koller with Tang Pei-sung, Director of the Botany Institute, Academia Sinica and leader of the visiting delegation. Photographs by P. Chvany.





*Members of the delegation of botanists from the People's Republic of China on a tour of the grounds and greenhouses of the Arnold Arboretum. Top left: Yu Te-sun (left) and Wu Cheng-yi studying *Euptelea polyandra* along the Chinese Walk. Top right: John H. Alexander showing the delegation the seedlings which resulted from the Arboretum's collecting trip to Japan and Korea in 1978. Bottom: A group photograph on the front steps of the Administration Building. Clockwise from lower right: Shiu-ying Hu, recently retired Arnold Arboretum botanist; Hsu Jen, Research Scientist, Botany Institute, Academia Sinica; Wu Cheng-yi; Yu Te-tsun; Sheng Cheng-kui, Director and Research Scientist, Kiangsu Botanical Garden, Academia Sinica; Li Hsin-hsueh, Research Associate, Nanking Institute of Geology and Paleontology; Peter Shaw Ashton; Su Feng-lin, Department Head, Foreign Affairs Bureau, Academia Sinica. Photographs by P. Chvany.*

August 1978, and at the Eighth World Forestry Conference at Jakarta, Indonesia, in October 1978; he lectured at the University of Massachusetts, Amherst, and at the University of Toronto; and during June and July 1979 he curated the dipterocarp collection at the Royal Botanic Gardens, Kew. He continued to serve on a National Academy of Sciences committee charged to establish research priorities in tropical biology, which met during the year at St. Louis and at Xalapa, Mexico. He also served on the National Academy of Sciences/Commonwealth Science Foundation consultative panel on crop diversification in the West Indies, which met at Port of Spain, Trinidad, in April 1979. In the coming year he and Dr. Otto T. Solbrig will supervise Paul C. Cox, a graduate student who has been studying the pollination ecology and other aspects of the climbing pandan *Freycinetia reyneckii* in Samoa.

Dr. Richard A. Howard was on sabbatical leave for the year, during which time he held a Guggenheim Fellowship. From August 6 through 24, 1978, he studied at the Copenhagen, Aarhus, Stockholm, and Geneva herbaria, and contributed a paper at the Aarhus Symposium. From October through February, and again from May 9 to early June, 1979, he was based at the New York Botanical Garden. Between March 1 and May 2 he conducted field work in the West Indies; in Martinique and Guadeloupe he succeeded in his searches for plants described or reported by the early botanists Plumier, Hahn, and Duss, and not recently re-collected. He helped establish plots on the Soufrière of Guadeloupe to study seral succession following the 1966-67 eruption, consulted with the Guadeloupe Department of Forestry, and collaborated in further studies of seral succession on Pico del Oeste, Puerto Rico. From the middle of June until August 1, he was in England, studying in the herbaria and libraries at Kew, at the British Museum of Natural History, and at the Linnean Society. Dr. Howard lectured on his visit to the People's Republic of China three times in October 1978, in Weston for the Friends of the Arnold Arboretum, at the Harvard University Herbaria Building, and at the University of Washington; once in December, at the New York Botanical Garden; and once in April, at the University of the West Indies in Montserrat. He presented a lecture on the West Indies in Dr. Thomas Givnish's course, Biology 250, Tropical Ecology, and gave other lectures in New York and Montserrat.

Dr. Shiu-ying Hu, although retired, has continued her research on the flora of China, and her studies of medicinal plants. She receives numerous requests for advice about and identification of Chinese materia medica, and consequently has submitted for publication in Hong Kong a checklist of 2,196 drugs, each with its classical name, transliteration, botanical identification, English equivalents, and uses. Her special interest is ginseng and other medicinal Araliaceae, and she contributed a paper at the Second International Ginseng Symposium in Korea in September 1978.

Dr. Norton G. Miller published a paper on Pleistocene plant fossils from a deposit in northern Vermont (*Journal of the Arnold Arboretum*, April 1979, pp. 167-218), and has completed most of the research for another paper on mosses recovered from the same fossil bed. In addition, root nodules containing the remains of a nitrogen-fixing actinomycete were found in the fossil plant assemblage described in the paper last cited. Early in June, Dr. Miller and Dwight Baker, a Harvard graduate student, made a trip to the Gaspé Peninsula, Quebec, to collect living root nodule specimens of *Dryas*, *Shepherdia*, and *Elaeagnus*. These and the fossil nodules are now being studied by scanning electron microscopy. The fossils appear to provide the first direct evidence of the presence of nitrogen-fixing plants in early Late-Glacial settings. With financial help from the Harvard Graduate Society, Dr. Miller completed a catalogue of the fossil record of Quaternary bryophytes in North America. The catalogue is now in press. He also completed a manuscript on "Fossil Mosses as Paleoecological Indicators of Late-Glacial Terrestrial Environments", and gave a lecture at Pennsylvania State University and at Cornell University on "Disjunct Populations in the Gulf of St. Lawrence Area: A Paleobotanical Perspective". Dr. Miller attended the Fifth Biennial Meeting of the American Quaternary Association in Edmonton in September. He serves on the editorial boards of four journals. During the year he directed the research of three graduate students, Peter Alpert, Cecilia Lenk, and Brent Mishler.

Dr. Bernice G. Schubert was acting director at Cambridge for the first half of the fiscal year. In March 1979 she retired as editor of the *Journal of the Arnold Arboretum* to concentrate on her research on the genera *Desmodium* and its allies, and on *Begonia* and *Dioscorea* in the Americas. This past year she devoted research to the Leguminosae subtribe Desmodieae, especially *Desmodium*, and participated in a working group on legume systematics at and above the generic level at Kew in August 1978. She also continued her work on a monograph of the genus *Dioscorea*, which is very numerous from Mexico southward. Some *Dioscorea* species contain chemicals of pharmaceutical significance, such as the precursors of cortisone and the precursors of the sex hormones. In spite of this, there is no recent monograph or easily usable account to aid chemists and pharmacologists in identification.

Dr. Stephen A. Spongberg's research continued to center on the taxonomy and relationships of genera of woody plants, particularly those in eastern North America and eastern Asia. It is from these genera that the large majority of our native and exotic woody ornamentals have been selected, and it is these genera that are so well represented in the Arnold Arboretum's living collections and in the herbaria. The taxonomic work on these genera will result, over the course of the years, in a series of treatments that can be brought together as a basis for a new manual of cultivated trees and shrubs.

While the new manual may be slowed by monographic and revisionary studies, particularly of large and complex genera such as *Sorbus*, it will profit greatly, since the large and complex genera are the least satisfactory in Rehder's *Manual*. It will be recalled that Rehder's *Manual* was itself largely a condensation of his monographic and revisionary studies.

During the past year, Dr. Spongberg and Ida H. Burch, staff assistant, published a treatment of the Lardizabalaceae (*Journal of the Arnold Arboretum*, April 1979, pp. 302-15), and Dr. Spongberg prepared for publication a treatment of the Cercidiphyllaceae (*Journal of the Arnold Arboretum*, July 1979, pp. 367-76). Drs. Spongberg and Stevens also collaborated in preliminary observations of Cercidiphyllaceae that may elucidate the growth patterns and architecture of this isolated and ancient family. Subsequent to Dr. Spongberg's 1972 revision of the genus *Stewartia*, new information concerning hybridization has suggested that numerous *Stewartia* plants in cultivation in western gardens are of hybrid origin. To supplement morphological studies and to resolve the status of putative hybrids more completely, an experimental hybridization program was undertaken in the Arboretum living collection during the summer of 1978, and was scheduled to continue during 1979. Last summer, apparently viable seed was obtained from four interspecific crosses and their reciprocals; cytological materials are also being processed for both the parental species and the putative hybrids. Dr. Spongberg has continued a taxonomic review of members of *Hartia*, a genus indigenous to southeastern Asia, and doubtfully distinct from *Stewartia*. There are only limited collections of *Hartia* in Western herbaria; while a loan has been received from Academia Sinica in Peking, many of the types as well as additional collections are housed in other herbaria throughout China. In recent discussions, botanists from the People's Republic of China have assured Dr. Spongberg that loans of specimens now can be arranged. Dr. Spongberg is also gathering materials of the genus *Sorbus* preliminary to taxonomic review of this poorly understood and difficult genus of the Rosaceae. Initial emphasis will be on the simple-leaved species that comprise sections *ARIA* and *MICROMELES*, but as work progresses, the survey will include the compound-leaved species, a group that has received much more attention, particularly in Europe, but never on a world-wide or monographic basis. The Arboretum has an excellent collection of *Sorbus*, and Dr. Spongberg hopes to supplement his morphological analysis with information gained from plants growing under cultivation. The information also may be used to assess generic boundaries within subfamily Maloideae. Subject to several interpretations in the past, the definition of genera within Maloideae remains to be analyzed critically.

Dr. Peter F. Stevens completed the final draft of his monograph of the large, taxonomically difficult, but important pantropical tree genus *Calophyllum*, whose 178 species are concentrated in the Far

East. His field and herbarium research involved several novel approaches, including the use of seedling branching and leaf arrangement to discriminate between critical species. He is beginning a survey of the seed structure of Indo-Malesian members of the tribe Vaccinieae (the blueberries, family Ericaceae), including a comparison with other taxa in the tribe, and is collaborating with Dr. B. A. Bohm, Vancouver, on a survey of leaf phenolics in tropical Vaccinieae, and a comparison of the variation found in leaf phenolics with variation in morphological and anatomical characters. Dr. Stevens and Paul Groff, a Harvard undergraduate, are surveying the generic limits of the tribe Phyllodoceae of the family Ericaceae; the survey involves a study of growth patterns and anatomy, and comparison with the variation in morphological and other characters in the tribe. Drs. Stevens and Richard E. Schultes are supervising graduate student Jeffrey Hart's research on *Lepechinia* and other South American Labiatae.

Dr. Richard E. Weaver, Jr., has continued his research on *Staphylea* and cultivated Hamamelidaceae. He also has been occupied with the verification of plant identifications, and the planning of the living collections accessions policy. During the first half of the year, he was acting director at Jamaica Plain.

Dr. Carroll E. Wood supervised the preparation of illustrations of monocotyledons for a new edition of his book *A Student's Atlas of Flowering Plants*. The first edition contained 120 illustrations of dicotyledons; for the second edition, Dr. Wood is adding sixty-four pages on monocotyledons, an additional glossary, and other material. Walter Judd, a graduate student working under Dr. Wood's supervision, received the Ph.D. from Harvard in November for his monumental and exhaustive thesis, *A Monograph of Lyonia (Ericaceae)*; he was appointed assistant professor in botany at the University of Florida in September, and in the spring of 1979 he was placed in charge of the vascular plants in the university herbarium. Dr. Wood continues to supervise Christopher Campbell's biosystematic researches on the *Andropogon virginicus* complex in the Southeast, and Michael Donoghue's studies of Central American *Viburnum*.

## EDUCATION

Graduate student projects have been reported under Research.

This year Dr. Stevens taught a graduate course, Biology 352, on his specialization, Systematics of Tropical Plants. Also, he was responsible for the systematic part of Biology S-105, Plants of the Tropics, which he taught with Dr. Jack Fisher in June and July 1978, and with Dr. P. Barry Tomlinson in June and July 1979; and for the botanical part of Biology 148, Principles of Systematics, which he taught with Dr. William L. Fink.

Dr. Wood had exceptionally high ratings in the student evaluations

of his introductory taxonomy course, Biology 103, The Taxonomy of Seed-bearing Plants, and of his part of the collaborative course, Biology 18, Diversity in the Plant Kingdom. The rating for Biology 103 was the highest of any course in the biology department, which received the highest rating of any department in the University. Dr. Wood gave his graduate research course, Biology 313, Systematics of Vascular Plants, in both semesters.

Dr. Miller also had exceptionally high ratings in his part of Biology 18. He gave a seminar both semesters for graduate students, Biology 305, Topics in Bryology and Paleobotany.

Drs. Sponberg and Weaver's experimental University Extension Course, Biology E-146c, Botanical and Horticultural Practices at Arboreta, reported in the last Director's Report, was completed by twelve summer horticultural trainees at Jamaica Plain in 1978. In a final discussion, the participants concluded that the benefits did not outweigh the considerable effort involved in the course, and it has been decided not to continue the course in the future.

Our public education program is on the threshold of accelerated expansion. As part of a policy to augment public programs, we have created the new position of plant information coordinator, with responsibility for answering inquiries, organizing exhibitions, and broadening our education program. Eugenia Frey was appointed to begin this position in July 1979. Course offerings in 1978-79 were increased from a standard ten or twelve of a few years ago to thirty-two for the year. Although we continue to offer many of the courses popular in the past, such as courses on pruning and plant identification, there has been increasing demand for scientifically oriented courses. On a trial basis, we offered courses on Basic Tree Biology, and Mosses and Liverworts. Both had full registration. Gary Koller contributed to seven courses during the year; Dr. Weaver, five; Margo Reynolds, three; John Alexander and James Burrows, two each; Dr. Miller and Robert Williams, one each; and Ida Burch, one, with the assistance of Helen Fleming and Anne Sholes. Class registrations for the year numbered 508, an increase of 89 over last year.

Staff members contributed to a monthly series of lunchtime lectures in Jamaica Plain during the winter, and at Meet the Staff Evenings in Weston during the spring. Dr. Miller organized the botany seminars, which met in the Herbaria Building every Thursday during the academic year.

Owing to a shortage in staff, the Arnold Arboretum was unable to exhibit this year at the New England Spring Flower Show. However, the Arboretum presented a new award, known as the Arnold Arboretum Award, for excellence in the use of unusual north temperate hardy woody plants in a complementary landscape setting. The first award was given to the Wellesley Garden Club for an exhibit featuring members of the heath family, the Ericaceae.

This year the Arboretum was staffed on May 20 for the Lilac Sunday

open house. The lilacs were somewhat early, and attendance was high on both this and the previous weekend. Open house at the Case Estates took place on Mother's Day, May 13; drizzle kept all but the most hardy visitors away.

Tours were organized for twenty groups of plant scientists and nurserymen during the past year, and some 150 individuals made professional visits. The Arboretum staff answered 290 technical requests or inquiries concerning the living collections and herbarium by letter, and at least double this number by telephone. A survey undertaken between April and December 1978 revealed that some 200 poisonous plant inquiries were received by telephone at the Arboretum during that period.

### PUBLICATIONS

The Arboretum publishes two periodicals: the *Journal of the Arnold Arboretum*, a quarterly journal for original work in systematics and other aspects of whole plant biology; and *Arnoldia*, a bimonthly journal providing authoritative articles in plain English for readers with a serious interest in the cultivation of woody plants. The Arboretum also publishes books, and various brochures, maps, and postcards for public sale.

We are convinced there is a considerably larger market for our publications than the one they presently serve, and that our publications as a whole could be made self-supporting, a goal that will become vital as inflation increases. Therefore, our publications program also has undergone major changes this year. Under the chairmanship of Dr. Schubert, the Arnold Arboretum, the Gray Herbarium, and the Farlow Herbarium have formed a joint Publications Committee to define policy for their various journals and to insure maintenance of the highest standards in all their publications. Also, an Editorial Committee has been constituted for *Arnoldia*, and will include the editor, the managing editor, the public relations coordinator, and a horticulturist from outside the University. A new position has been created for a publications officer, who will be responsible for executing all future publications at Jamaica Plain, and who will be managing editor of *Arnoldia*. Norton Batkin was appointed to begin this position in August 1979.

Dr. Schubert this year completed fifteen years as editor, and, latterly, chairman of the Editorial Board, of the *Journal of the Arnold Arboretum*. During this period she sacrificed much of her research time to dedicate herself to maintaining the highest standards in the *Journal*, thus continuing the tradition of excellence set by her predecessor, Dr. Wood. Dr. Schubert stamped her personality on the *Journal* through vigorous attention to style and detail. We owe her a great debt. Dr. Spongberg assumed editorship in early 1979. Elizabeth Schmidt continues as assistant editor. During the fiscal year,



twenty-five papers from thirty-three authors have been published, comprising 554 pages.

The editorship of *Arnoldia* also changed during the year. Jeanne Wadleigh, who had managed *Arnoldia's* affairs almost singlehandedly for seven years on a part-time basis, resigned in the spring. To her, too, we owe special gratitude. Working under difficult and sometimes very frustrating circumstances, she nevertheless improved *Arnoldia* in style, and increased its circulation. Dr. Weaver has taken her place as editor. The six numbers of *Arnoldia* during this fiscal year comprised 361 pages, and contained eleven articles, all by staff, and nineteen book reviews, of which seven were contributed by volunteers, and one by a student intern.

Four books are in various stages of preparation at the Arboretum. The third volume of Dr. Howard's monumental *Flora of the Lesser Antilles*, and the first written largely by himself, was published in July 1979. Its 586 pages treat the thirty-five monocotyledonous families occurring in the Lesser Antilles. Dr. Howard is also collaborating with photographer and film director Peter Chvany on a book on Ernest Wilson's life and his work in China, richly illustrated with Wilson's photographs. Dr. Weaver and Esther Heins, a Friend of the Arboretum, began preparing for publication some of Esther Heins's eighty superb watercolors of plants growing in the Arboretum. Ida Burch and Dr. Spongberg are working with Dr. Frederick H. Lovejoy, Jr., the director of the Massachusetts Poison Control Center, on a book on the poisonous plants of the northeastern United States. The Arboretum already has produced a highly successful film and devoted an issue of *Arnoldia* to the potential hazard of the small group of plants toxic to man. However, a need still exists for a well-illustrated guide to the identification of these plants, and it is to this end that Ida Burch and Dr. Spongberg have begun to work on the new book.

In April 1979 Dr. Spongberg and Ida Burch attended a symposium at the New York Botanical Garden on "Poisonous Plants in Urban and Suburban Environments".

#### PUBLIC RELATIONS

We serve the public as an amenity, through *Arnoldia* and other publications, through our course programs and exhibits, and through our public information program, including answering emergency requests for poisonous plant identifications. The sections on Education and on Publications have included reports on the courses and on *Arnoldia* while the number of requests by letter and telephone, including poisonous plant inquiries, to which we have responded have been mentioned under Living Collections. In the spring of 1979 a Public Relations and Education Committee, under the chairmanship of Margo Reynolds, was formed. This was the first step in a plan to increase the services provided by the Arboretum to the Friends of the Arnold

Arboretum and to the public at large, particularly the citizens of Boston.

Our Volunteer Program enables the public to share our work. Over the years we have come to rely on our volunteers to such an extent that it would be difficult at Jamaica Plain and at Weston to function without them. From them we receive wise counsel, and dedicated and faithful support, and their presence adds vitality and enthusiasm to our working atmosphere. We suspect that our volunteers also enjoy working with us. We plan to encourage more volunteers to join us, especially from our neighboring communities, where such individuals may act as spokesmen for the Arboretum. This year we were privileged to have thirty-six volunteers, of whom six joined since March in response to a new search system. Volunteers taught classes, curated the slide collection, assisted in clerical work and several mailings, gave tours, worked in the greenhouse, compiled nursery inventories, prepared exhibits, helped with a survey of nursery catalog holdings, staffed the entrance desk, collected specimens from the living collections, and helped research our early history.

Four new exhibits were featured in the Arboretum's lecture hall during the year. From July through September a fine photographic exhibit of flower close-ups by David Stone was on display. A major exhibit entitled "Spreading Roots" and offering a comprehensive look at the history of plant introductions in North America was mounted in October, prepared by volunteer Cora Warren with the assistance of Ida Burch. Following an opening on October 8 for Friends and their guests, the exhibit continued until the New Year. On January 7, over 250 people, the largest attendance we had ever received at an opening, viewed an exhibit, entitled "Caribbean Flora", of watercolors of subtropical and tropical flowers by the late Edith Farrington Johnson. On April 1, 350 people attended the opening of Harry White's remarkable "Fleurage", an exhibit of his delicate and highly decorative petal montages.

The total number of registrations for our various classes, lectures, and exhibitions was 1,712, representing a considerable increase over the 763 of the previous year.

Six traveling exhibits were completed during the year. Four were sent to libraries in the greater Boston area.

As part of our public relations program, we are intensifying a campaign to strengthen ties with our neighboring communities. In the final negotiations over the fate of the Adams-Nervine property, we adopted a common stance with the Jamaica Hills Association, on which staff member Gary Koller now serves. We hope to maintain and strengthen our ties with the Jamaica Hills and other neighborhood associations by sharing our future plans with them. In this endeavor, Friend and Visiting Committee member Leo McCarthy has continued to give valuable advice and help. Citizens of Roslindale organized a meeting, to which we were invited, of representatives of



Over 250 Friends of the Arboretum and invited guests gathered on Sunday, January 7th, 1979, for the opening of the "Caribbean Flora" exhibit in the Arboretum's lecture hall. Some thirty-four watercolors of tropical and sub-tropical plants by the late Edith Farrington Johnson comprised the exhibit. Opening day guests were treated to a festive tropical atmosphere created by staff and volunteers, with Hawaiian and Caribbean music playing in the background and an exotic smorgasbord of tropical delicacies including tamarind juice, curried mangoes, papaya mousse, and other unusual foods.



*On May 17th, 1979, a reception was held in Jamaica Plain for sponsors, patrons, and donors of the Arnold Arboretum to thank them for their generous support of our activities. Following an informal reception in the lecture hall featuring May wine and hors d'oeuvres, Dr. Ashton delivered a brief address outlining his hopes for the future of the Arboretum and invited the group's suggestions and continued participation. A special feature of the evening was a bus tour of the Arboretum to visit the new walk below the dwarf conifers, the refurbished Bussey Hill summit, and the greenhouses, where the Friends were able to see the seedlings obtained during the Arboretum's 1978 collecting trip to Japan and Korea. Those in attendance were given several of these small, choice plants as gifts.*

their community, the local police, and the police commissioner to discuss the problem of security and of teenage drinking in the Peters' Hill section of the Arboretum. The director, the superintendent of buildings and grounds, Robert Williams, and staff member and Jamaica Plain resident, Ida Burch, attended. The meeting proved both lively and productive, leading to further contacts which we intend to develop.

In the spring of 1978 the Arboretum offered the Boston Urban Gardeners the use of land on the South Street tract for a community vegetable garden. We agreed to disc the land in the spring and fall, to sow a winter cover crop, to provide lime and compost when available, and technical assistance and use of the Arboretum Library at Jamaica Plain. During the first trial, the gardens were plagued by water problems, vandalism, and inadequate organization by the gardeners. However, the gardeners refused to be beaten, and although the problems have not been overcome completely, an overwhelming number of the pioneers voted to try again this summer, with a new volunteer coordinator providing a much smoother, more efficient organization. The group is now installing a Savonius pump and water storage facility.

#### FRIENDS

Margo Reynolds, with the assistance of Barbara Epstein, coordinated an effort to attract new Friends, coupled with an ongoing series of lectures and special events for the current membership.

Three of the exhibits in the Jamaica Plain lecture hall last year opened with special Friends previews. Attendance by Friends and their guests increased with each exhibit opening and culminated in a record 350 people at "Fleurage".

On October 5 a special lecture, arranged by the Arnold Arboretum, and jointly sponsored with the Fogg Museum and the Massachusetts Horticultural Society, was presented for the Friends of the three institutions. Nearly 350 people assembled at the Fogg Museum to hear Paul Miles, horticulturist for England's National Trust, speak about the reconstruction and renovation of some of England's historic gardens.

Members of the Friends organization shared their experiences with others in the popular Evenings with Friends series. Six programs were presented, including a double showing of Dr. Howard's program on his trip to China.

PETER SHAW ASHTON

*Appendix: Published Writings of the Staff and Associates*  
*July 1, 1978 — June 30, 1979*

- Alexander, J. A. III (with G. L. Koller). The raisin tree — its use, hardiness and size. *Arnoldia* 39(1): 7–15. 1979.
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### Appendix:

#### Weather Station Data For 1978

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Extreme Max. (°F)	Extreme Min. (°F)	Precipitation (inches)	Snowfall (inches)
Jan.	34	16	25	57	4	8.92	33
Feb.	35	13	24	46	–1	2.30	27+
Mar.	45	24	34	62	7	3.21	13
Apr.	56	36	46	69	25	1.93	—
May	69	47	58	92	29	5.25	—
June	81	55	68	91	43	1.39	—
July	86	62	74	99	45	1.82	—
Aug.	82	62	72	95	53	4.37	—
Sept.	74	48	61	89	35	1.12	—
Oct.	63	40	51	81	25	3.30	—
Nov.	52	34	43	73	14	2.18	2
Dec.	41	24	32	54	10	4.22	5

Average maximum temperature	60°F
Average minimum temperature	38°F
Precipitation	40.01"
Snowfall	80"
Warmest temperature	99°F on July 24
Coldest temperature	–1°F on February 4 and 5
Date of last frost in spring	May 1
Date of first frost in autumn	October 9
Growing season*	161 days

\* The growing season is defined as the number of days between the last day with killing frost in spring and the first day with killing frost in autumn. This period is determined by the last spring and the first fall temperature of 32°F or lower.

Weather Station Data for the First Six Months of 1979

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Extreme Max. (°F)	Extreme Min. (°F)	Precipitation (inches)	Snowfall (inches)
Jan.	37	21	29	55	2	12.17	7
Feb.	30	13	21	57	-6	3.51	7
Mar.	49	33	41	72	11	2.83	—
Apr.	57	37	47	78	26	4.44	2
May	70	52	61	96	36	4.12	—
June	81	54	68	93	43	.96	—

Average maximum temperature	54°F
Average minimum temperature	35°F
Precipitation	28.03"
Snowfall during winter 78-79	23+"
Continuous snowcover	February 8-21, 1979
Warmest temperature	96°F on May 11
Coldest temperature	-6°F on February 14 and 15
Date of last frost in spring	April 21
Continuous freezing temperature	February 6-20, 1979

JOHN H. ALEXANDER III

*Appendix: Staff Members of the Arnold Arboretum*

*Who Left or Retired During the Fiscal Year 1978-79.*

Michael A. Dirr, *Mercer Fellow*

Carolyn S. Hesterberg, *Herbarium Secretary\**

M. Katherine Holland, *Secretary*

Mohammad Nabi Jadidi, *Mercer Fellow*

Donna A. Lynch, *Curatorial Assistant*

Bruce E. McCutcheon, *Grounds Staff*

Angus MacNeil, *Grounds Staff*

Angello Navarro, *Grounds Staff*

Laura F. Sahagian, *Secretary*

Jill S. Karstad, *Library Assistant*

M. Brooke Thompson-Mills, *Research Assistant*

Jeanne S. Wadleigh, *Editor, Arnoldia*

Robert G. Williams, *Superintendent of Buildings and Grounds*

\* Joint appointment by the Arnold Arboretum and the Gray Herbarium

## NOTES FROM THE ARNOLD ARBORETUM

### The Collections Policy of the Arnold Arboretum: Taxa of Intraspecific Rank, and Cultivars.

*The following is based on a discussion memorandum submitted to the Living Collections Committee by Stephen A. Spongberg. The proposals made in that memorandum were accepted by the committee at their meeting on November 7, 1979, and are now part of the collections policy of the Arnold Arboretum. Ed.*

The living collections of the Arnold Arboretum of Harvard University are a national and international resource to both the botanical and horticultural scientific communities. According to the original indenture of the Arboretum, all plants hardy in the vicinity of West Roxbury, Massachusetts, were to be collected and grown on the Arboretum grounds. This collections policy was almost immediately restricted, with some exceptions, to woody plants. As modified, the policy has continued and has recently been reasserted. The Arnold Arboretum has as its goal to cultivate all those woody plant species that are hardy and able to withstand the climate of the Boston Basin. Three individuals of each species are grown, and an attempt is made to grow individuals originating from different points within the geographical range of the species to insure genetic and phenetic diversity. Plants of documented wild origin are highly preferred over those of nursery or garden origin. While the collections of the Arnold Arboretum are not complete by these standards, work continues towards the acquisition and maintenance of an all-inclusive collection so far as that is possible.

One of the major questions the above policy raises concerns the collections policies for taxa of infraspecific rank and for that class of plants known as cultivars. Specifically, should the collections policy of the Arnold Arboretum be restricted to the species level, or should the policy extend to include taxa at all infraspecific levels and to cultivars as well? The following discussion attempts to elucidate the problems involved and to state clearly the policies recently integrated with the overall collections policy of the Arnold Arboretum.

Many species of woody plants have been studied in detail by taxonomists, either during the course of monographic or revisionary work or during more general floristic studies. In numerous instances, particularly those involving wide-ranging species, the patterns of morphological variation, as well as variations in other characters, have suggested biologically valid subunits of the species. These subunits have been proposed as infraspecific taxa and accorded names at the ranks of subspecies, variety (Latin, *varietas*), and form (Latin, *forma*), or a combination thereof, depending upon the philosophy of the taxonomist. It is probably safe to assert that species of ornamental and economic importance, and species with a long history of cultivation, have been subject more frequently to taxonomic review, and in consequence there are sometimes several taxonomic treatments from which to choose. It also should be noted that taxonomic treatments at the infraspecific level are subject to change or modification as additional data become available; while the same is true at the species level, in practice fewer changes involving taxonomic evidence result.

Since taxa of infraspecific rank often may be rejected by future taxonomists, is it valid to include living representatives of these taxa in the collections of the Arnold Arboretum? What reasons would justify the considerable expenditures required to collect and maintain living representatives of infraspecific taxa in our collections? The primary reasons in support of the inclusion of these taxa are outlined below.

1. There is an historical precedent. Many of the plants in our collections represent infraspecific taxa, and Charles Sprague Sargent, the Arboretum's first director, included them in practice if not in name. Examples in the living collections are *Magnolia acuminata* (L.) L. var. *subcordata* (Spach) Dandy and *Tsuga canadensis* (L.) Carr. f. *pendula* Beissner, Sargent's weeping hemlock.

2. If the typical infraspecific taxon is not hardy in the Arnold Arboretum, but another infraspecific taxon of the same species is hardy, then the species must be represented by a subspecies, variety, or form. Examples are *Davidia involucrata* Baillon var. *vilmoriniana* (Dode) Wangerin and *Cedrus libani* A. Rich. subsp. *stenocoma* (Schwarz) Davis.

3. Infraspecific taxa other than the typical one(s) often exhibit

a range of variation within the species that is of considerable taxonomic and evolutionary significance or interest. When grown together, representatives of these taxa illustrate the genetic and phenetic diversity of the species. Examples are *Kalmia latifolia* L. and its formae *latifolia*, *fuscata* (Rehder) Rehder, *polypetala* (Nichols.) Rehder, and *rubra* Sweet ex K. Koch; and *Hydrangea arborescens* L. and its subspecies *arborescens*, *radiata* (Walter) McClintock, and *discolor* (Seringe) McClintock.

4. Intraspecific taxa are often restricted to limited geographic ranges in nature and may, as a result, be more vulnerable to extinction. Since the Arnold Arboretum collections serve as a living gene bank, inclusion of rare, endangered taxa is highly desirable. *Hudsonia ericoides* L. subsp. *montana* (Nuttall) Nickerson & J. Skog, known from only one area of Burke County, North Carolina, is an excellent example.

5. Variants that have been accorded infraspecific rank are often difficult to locate in nature if their ranges are limited, and their inclusion in the living collections of the Arnold Arboretum provides scientists and others more ready access. *Sorbus sambucifolia* (Cham. & Schltdl.) Roem. var. *pseudogracilis* C. K. Schneider, endemic to alpine regions in northern Honshu and Hokkaido, is an excellent example.

6. By collecting and growing in one location the infraspecific taxa of a species, comparisons among the taxa are facilitated, and environmentally induced characters can be assessed.

7. Living representatives of infraspecific taxa, particularly authentic material, aid greatly in the accurate identification of incoming material, either living or dried. The *Lonicera*, *Philadelphus*, and *Chaenomeles* collections in the Arnold Arboretum are particularly rich in infraspecific taxa and represent materials that have been studied in detail by Arboretum taxonomists.

8. Variants based primarily on habit are difficult to assess and study on the basis of herbarium specimens, and living representatives are essential to critical taxonomic studies. Numerous examples could be cited from the genera of conifers in our collections.

9. Variants are sometimes of greater economic and/or horticultural importance than the typical infraspecific taxon, and representatives of these taxa, when grown together, often provide living examples of concepts difficult to convey to students of botany and horticulture. In particular, representatives of these taxa are extremely helpful in illustrating the taxonomic concepts of subspecies, variety, and form, and the criteria employed in their definitions. *Cornus kousa* Hance var. *chinensis* Osborn illustrates this use.

The possibility that in the future some infraspecific taxa may be rejected provides what might seem a strong argument against a policy of including infraspecific taxa in the living collections of the Arnold Arboretum. Alternatively, if infraspecific taxa were included, it

might yet be argued that if a particular variety is no longer accepted by the most recent monographer, the plants now growing in our collections should be deaccessioned or at least relabeled with the currently accepted name. There are several reasons, we believe, why these arguments should not be reflected in our collections policy.

In the herbarium, when a new taxonomic treatment is published, specimens may be annotated with the names adopted in the revisionary study, and changes in rank and interpretation noted. The specimens may also be rearranged to reflect the new system of classification. But in every instance, the annotation labels are applied to the sheets so as not to obscure previous annotations and the names and ranks under which the sheets had been filed, and as a result, the specimens could, if one wanted, be restored to their former arrangement. In any case, future workers are able to see at a glance the determinations of earlier workers. The same system, slightly modified, should be applied to our living collections, particularly with regard to taxa of infraspecific rank. Any taxonomist undertaking revisionary or monographic studies must attempt to account for all the names published in his group, and in many instances those published at infraspecific rank prove most difficult to trace in the literature, and specimens are also often few and inadequate. To be able to study living plants of these erstwhile taxa greatly facilitates such research and would be one of the primary benefits of our living collections.

Based on the above arguments, the collections policy of the Arnold Arboretum now includes the amended phrase, "all those woody plant species and their infraspecific taxa hardy in the vicinity of West Roxbury, Massachusetts," and our goal for infraspecific taxa, as for species, is to grow three individuals of each taxon in Jamaica Plain or Weston. Considering space and the current number of acquisitions in our collections, this goal is realistic. In those instances where infraspecific taxa are extremely rare, threatened with extinction, or of great ornamental or scientific value, the number of individuals might be increased.

Once the term "cultivar" (coined in the 1950's from the two words "cultivated" and "variety") was adopted in the first edition of the *International Code of Nomenclature for Cultivated Plants*, many horticulturists added to the confusion of what a cultivar is through their wholesale and often uncritical transfer of taxa of botanical rank (e.g., subspecies, varieties, in the botanical sense of *varietas*, and, particularly, forms) to cultivar status. In these transfers they simply adopted the Latin-form botanical epithet as a cultivar name and in print either set the name off in single quotes or preceded the name with the abbreviation "cv". These transfers are totally without basis since the category of cultivar is without rank within the botanical hierarchy of classification and in particular is not to be equated with any infraspecific botanical rank. Whether or not taxa that have

received such treatment are considered valid infraspecific taxa worthy of recognition from a taxonomic standpoint in our living collections, their names will henceforth be treated not as cultivar names but as botanical names, as was the intention of their authors. In particular, the same policies will be applied to these taxa in our living collections as are applied to infraspecific taxa in general.

In the *International Code* the term "cultivar" has a wide conceptual definition and a potentially wide range of application. However, when dealing with woody plants, the term is almost always applied to a clone developed from a particular individual plant (one genotype) selected for a specific character or a specific combination of characters. The origin of the parent plant, whether wild or cultivated, is not of immediate importance nor is its botanical classification since cultivar names (fancy or vernacular) are not intended to reflect botanical classification. Nonetheless, the majority of cultivars are selected from individuals of a species, and in many instances from individuals of an infraspecific taxon. Others are selected from progeny of interspecific or infraspecific hybridizations and as a consequence represent hybrid combinations that may be of considerable botanical interest. In practice, the primary difference between a woody plant cultivar and plants that comprise a botanical taxon lies in the fact that the former is selected by man and is named without regard to the botanical classification of the plant concerned. Species and infraspecific taxa, on the other hand, are investigated and named within the framework of systematic botanical classification. Moreover, botanical taxa are meant to reflect the results of the process of evolution and are conceptual entities since they apply to numerous genotypes, rather than a particular genotype.

Cultivars can be identified and given botanical names, and many cultivars may represent infraspecific taxa not otherwise represented in the living collections of the Arnold Arboretum. In other instances a series of cultivars may represent the range of variation within a species. Many cultivars are plants of horticultural importance. However, particularly in genera of high ornamental appeal, new cultivars are continually being introduced, and old clones are usually not maintained when their favor in horticultural circles is eclipsed. A major drawback to the inclusion of cultivars in a living collection intended to serve scientific purposes is the fact that most cultivars are of undocumented origin, and little information can be obtained concerning them in the literature or from cultivar registration authorities.

On the basis of the above considerations, the collections policy of the Arnold Arboretum now includes the following guidelines for inclusion of cultivars in the living collections.

1. Cultivars with Latin-form names are to be reestablished in our collections and in our records as botanical taxa unless it can be shown that the Latin-form name was intended by its author to represent a cultivar (clonal) name.





*Magnolia kobus* var. *loebneri* 'Merrill', a hybrid between *M. kobus* var. *kobus* and *M. kobus* var. *stellata* developed at the Arnold Arboretum. It was named in 1952 by Dr. Karl Sax, director at the time, in honor of Dr. Elmer Merrill, former director. An outstanding ornamental plant combining the best characteristics of its parents, *Magnolia* 'Merrill' recently won for the Arnold Arboretum the Reginald Cory Memorial Cup from the Royal Horticultural Society. Photograph by G. L. Koller.

2. Except under special circumstances, no cultivar is to be grown without first obtaining and recording adequate documentation of its origin and other available information, including published references.

3. The botanical identity of those cultivars grown is to be determined wherever possible.

4. Cultivars are to be grown for a specific purpose. Examples include named hybrids of botanical interest, e.g., *Magnolia* 'Freeman', a hybrid between *M. virginiana* L. and *M. grandiflora* L., or unusual individuals that exhibit one end of the range of variation in one or more characters of the species, e.g., *Hydrangea quercifolia* Bartram 'Snowflake'.

5. Cultivars of outstanding ornamental interest may be included in the living collections of the Arnold Arboretum only if their origins can be documented, and the clones are destined to remain unparalleled by other cultivars for a considerable period of time. Most of the cultivars that would fall into this group could be justified under 4, above.

Space permitting, two individuals will be grown of each cultivar that does not simultaneously fill other needs. This procedure will guard against the loss of the clone in our collections.

STEPHEN A. SPONGBERG

Right: Volunteer Leslie Oliver cleaning seeds at the Dana Greenhouses. Photograph by E. Gray.  
Back cover: Part of the Larch Collection (*Larix*) at the Arnold Arboretum after a snowfall. Photograph by P. Bruns.

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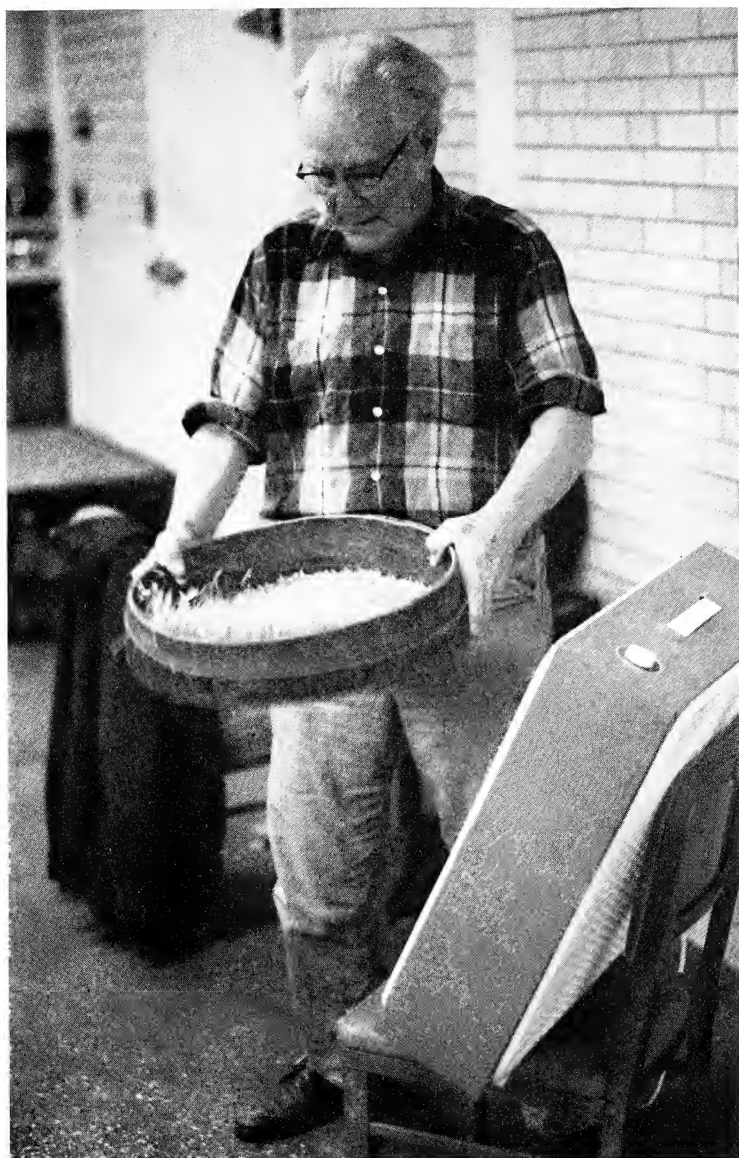
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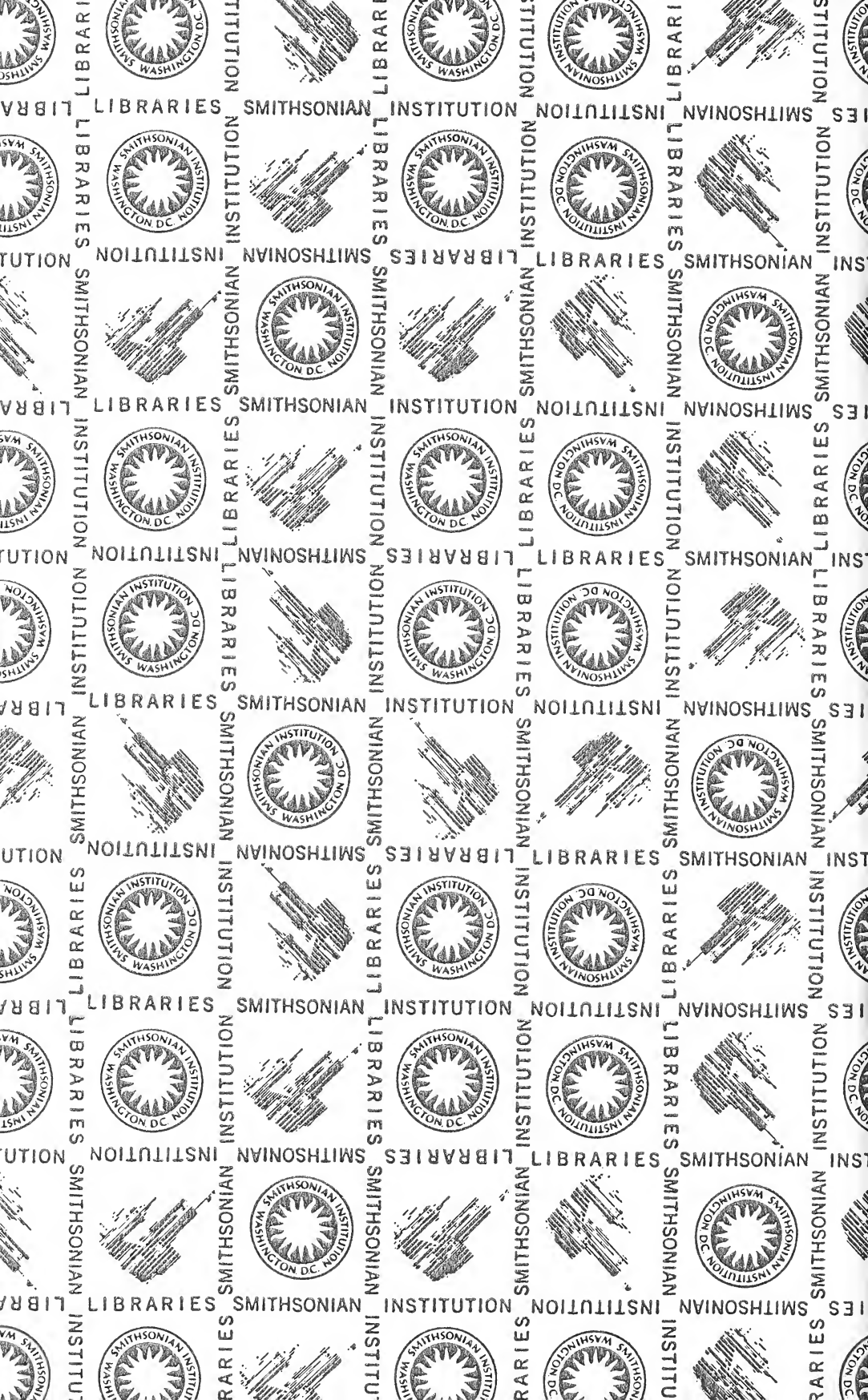


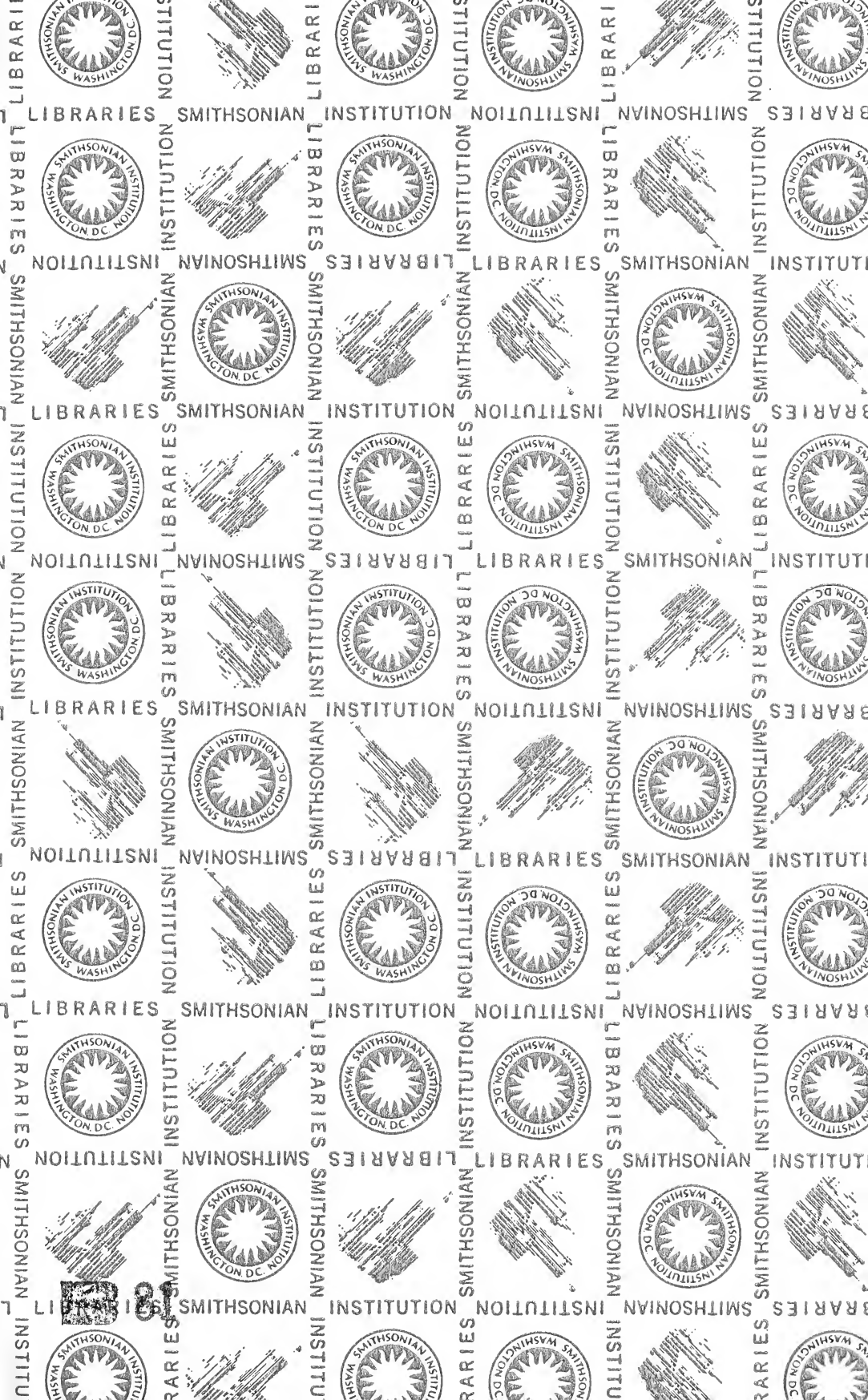
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